DOCUMENT RESUME

ED 383 576 SE 056 546

TITLE	The Museum of Solid Waste and Energy.
INSTITUTION	National Energy Education Development Project, Reston, VA.
PUB DATE	Oct 92
NOTE	61p.
AVAILABLE FROM	The National Energy Education Development (NEED) Project Headquarters, P.O. Box 2518, Reston, VA 22090.
PUB TYPE	Guides - Classroom Use - Teaching Guides (For Teacher) (052)
EDRS PRICE	MF01/PC03 Plus Postage.
DESCRIPTORS	Cooperative Learning; *Energy Education; Environmental Education; *Group Activities; Interdisciplinary Approach; Intermediate Grades; Junior High Schools; *Learning Centers (Classroom); *Lesson Plans; Middle Schools; *Museums; Recycling; *Solid Wastes; *Waste Disposal

ABSTRACT

This activity geared for grades 5-9 involves students in creating museum stations on eight solid waste and energy topics. While working in groups, students present their station topic to other students who are conducting a "museum tour." In doing so participants are encouraged to enhance their reading, writing, public speaking, and artistic skills in a cooperative learning activity. Station topics include solid waste, source reduction, recycling, waste-to-energy, and landfilling. A teaching guide contains information on teacher preparation and 5 days of lesson plans. Students complete a multiple choice energy survey at the end of the lessons (test included). Background information and step-by-step directions for setting up each of the stations is included. (LZ)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED 383 576

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

Mark E. Sprill

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

☑ This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

OF SOLID WASTE AND ENERGY

SE 053 516

BEST COPY AVAILABLE

CONTENTS

Teacher's Guide

Museum Survey
Museum Survey Order Form

Museum Backgrounders

Introduction to Solid Waste
Source Reduction
Introduction to Recycling
Plastics Recycling
Recycling Metals
Recycling Paper
Waste-to-Energy
Landfilling

Station Guides

Station 1 Guide
Station 2 Guide
Station 3 Guide
Station 4 Guide
Station 5 Guide
Station 6 Guide
Station 7 Guide
Station 8 Guide

The National Energy Education Development Project
October 1992

Printed on Recycled Paper

Teacher's Guide

What's Included in Your Kit

- Teacher's Guide (Includes sample museum survey and order form.)
- Eight Museum Backgrounders on solid waste and energy issues.
- Eight student Station Guides to accompany each Museum Backgrounder.

What is the goal of this activity?

Let's put it this way. Your students have probably visited a museum, but have they ever made one? That's just what they'll do for this activity. They'll create museum stations on eight solid waste and energy topics. In doing so, they will enhance their reading, writing, public speaking, and artistic skills.

Sounds interesting. Can you tell me a little more?

Sure. The Museum of Solid Waste and Energy is a cooperative learning activity. That means your students will work together in small groups (no more than two to four students) to complete their project. Each group will study one solid waste and energy topic, and then create a museum station to teach others about it.

What topics will my students learn about?

- ***Solid Waste***—What it is, how much Americans generate, what we can do to solve the problem.
- ***Source Reduction***—How we can reduce waste so there is less to be recycled, burned, or landfilled.
- ***Recycling***—What it is, what the advantages are, how different materials (plastics, paper, glass, aluminum, and steel) are recycled.
- ***Waste-to-Energy***—How waste can be burned to produce steam and electricity.
- ***Landfilling***—What a modern landfill is like, the landfill shortage, why landfilling is the safest disposal method for some types of waste.

The Museum Survey—Order Form

Do you know what packaging material is coded to help recyclers? Do you think Americans should be required by law to recycle at least some of their waste? Do you know what material accounts for 40 percent of the nation's waste? These are just some of the questions on the Museum of Solid Waste and Energy Survey. Students and adults across the nation will be participating in this very important survey. Don't miss this opportunity to let your students' opinions be known! Computer scanning cards and computer processing are **free**! Just fill out the form below and mail it to: **NEED Project Headquarters, P.O. Box 2518, Reston, VA 22090.**

Please type or print

Your Name _____ Date _____

Name of School or Youth Organization _____ Grade Level(s) You Teach _____

Street Address (*Please no P.O. Box numbers. UPS delivery requires street address.*) _____

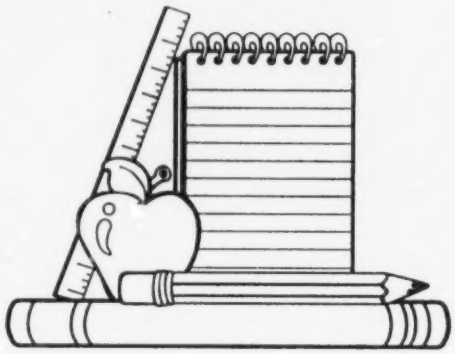
City/Town _____ State _____ Zip Code _____

(Area Code) Phone Number _____ Best hours to reach you on a school day.

How many canning cards do you need? (You may order as many as you need, but please order only **one** card for each student or adult taking the survey.) _____ **# of cards.**

What grade levels do you recommend for this activity?

This activity is geared for students in grades 5-9. We think the activity is ideally suited for the elementary teacher who has a self-contained classroom, but it would work well with junior high students too.



How long will it take my students to do this activity?

Your students can complete this activity in five days. You may add an extra day or two if you think your students will need more time to prepare their museum exhibits.

Are there some other ways I can use this activity?

We have designed this activity for classroom teachers who just want their students to create the museum for their classroom. But there is a lot more you can do with this very important activity! Here are just a few ideas.

School Activity—Invite all the students in your school (or in just one or two grades) to tour your students' museum. You may want to set up your students' museum in the gym, cafeteria, or hallway. Divide the visiting students into eight groups and rotate the groups through the stations. This will avoid a situation where everyone is crowded around one station at the same time. Give the visiting students the museum survey to get a census of what the students at your school know and think about solid waste and energy topics.

Hints:

- Secure eight tables, one table for each station, so your students will have a place to display their exhibits.
- Time your students' presentations for the eight museum stations. The presentations should take about the same amount of time; otherwise you will have a situation where one group is finished before the others.
- Keep groups of visiting students fairly small. Try to have no more than six students at each station.
- Set up chairs in front of each museum station. Students may get restless if they have to stand for the entire tour, plus, students tend to listen better when they are seated.
- Ask teachers from the visiting classrooms to administer the survey in their classrooms **before** and **after** the museum tour. Then collect the cards and send them to us for processing. The survey is great PR for your school.
- Record your students' tour presentations on a cassette tape recorder. This way, other classes could visit your museum without your students needing to be there. Modify the presentations to include instructions for using the cassette recorder, i.e., "Please press the rewind button at the end of this tour and move to Station Two."
- Take color slides of the museum stations and create a 24-minute slide show.

NEED Day Activity—Celebrate NEED Day (National Energy Education Day) with the Museum of Solid Waste and Energy. NEED Day is the always the third Friday in March.

Community Presentation—Make your museum move! Take your museum to another school, community center, PTA meeting, or shopping mall. Teach others in your community about solid waste and energy and show you care! Administer the survey to see what your community knows and thinks about some important solid waste topics.

Teacher Preparation

1. **Order cards. (Optional)**
   Order computer scanning cards for the museum survey. All you need to do is complete and return the Museum Survey Order Form to us. The cards are free, and you may order as many cards as you think you will need.

2. **Assign students to groups.**
   Assign your students to the eight stations. **Hint:** Try to achieve a good mix of student abilities for each station. Don't put all your artistic students in one group; spread the talent! Ideally, each station should have a good leader/speaker, a good writer, and a good artist.

   Station 1—Intro. to Solid Waste
   Station 2—Source Reduction
   Station 3—Introduction to Recycling
   Station 4—Recycling Plastics
   Station 5—Recycling Metals
   Station 6—Recycling Paper & Glass
   Station 7—Waste-to-Energy
   Station 8—Landfilling

3. **Make station folders.**
   Make an informational packet for each station. This is simple! Just put all the materials in a folder and label it with the station's name. Each folder should include:

   - the station's museum backgrounder. (One copy per student.)
   - the station's guide sheet. (One copy per student.)
   - any special materials you have collected.

4. **Collect art supplies and, yes, garbage!**
   Collect equipment/art supplies for students to use in making their exhibits.

   - overhead projector
   - transparency paper
   - posterboard, alphabet stencils
   - colored markers, crayons, paints
   - construction paper, tissue paper
   - empty cardboard boxes, cans, bottles

Lesson Plan for Day 1

Materials You Need Today: *One museum survey and scanning card for each student; No, 2 pencils; station folders.*

1. **Introduce activity to students.**
   Topics you may want to cover in your introduction include:

   - General overview of America's solid waste problem.
   - What solid waste topics your students will be studying (i.e., the eight stations).
   - How students should work together in small groups.
   - A timetable for working on the museum stations. (Write schedule on blackboard.)

2. **Administer the museum survey. (Optional)**
   Students must use No. 2 pencils to mark their answers on scanning cards. If you have very young students or poor readers, you may want to read the questions aloud as you offer explanations.

3. **Break students into stations.**
   Hand out the station folders. (Can you make eight stations in your classroom?)

4. **Go over student instructions.**
   Ask your students to take out their station guides and museum backgrounders. Explain how they will pattern their museum stations after the sample given for the first section of each group's backgrounder. (Please see the student guides for more information.)

5. **Monitor group work.**
   Students may now begin working on their own stations! You should monitor the groups' progress. You'll want to make sure students stay on the schedule you have outlined on the blackboard. If students run out of time, you may ask them to complete work at home or after school.

Lesson Plan for Day 2

Materials You Need Today: *Station folders*

1. **Monitor group work.**
   Students should complete steps 2 and 3 that are outlined on their Station Guides.

2. **Check work.**
   At the end of class time, ask students to hand in a rough draft of their museum scripts, or go around the room and check each group's work. ***Make sure their scripts include all the basic knowledge about their topics that is listed in each station guide under the box labeled "More Help."***

Lesson Plan for Days 3 and 4

Materials You Need Today: *Art supplies/equipment*

1. **Monitor group work.**
   Students have Days 3 and 4 to work on their museum stations and to refine their scripts. **Note:** If you think your class needs more time to create their stations, you may either instruct your students to complete their projects after school, or you may give them an extra day or two of class time.

2. **Review schedule for presentations.**
   Take a few minutes on Day 4 to go over the schedule for Day 5 (Presentation Day) with your students.

   - Your students need to know that they must set up their exhibits quickly tomorrow so that all the groups will have enough time to complete the presentation of their museum stations.
   - After the museum presentations, they will take the museum survey again.

Lesson Plan for Day 5

Materials You Need Today: *One museum survey and and scanning card for each student; No. 2 pencils. (Use the same scanning cards again; ideally each student should use the card he or she used the first time.)*

1. **Set up exhibits.**
   Today is the big day! There will be a lot going on today, so it's crucial to keep students on track. Once again, briefly explain to your students what will be expected of them today. Then give them three minutes to set up their stations.

2. **Begin student presentations.**
   Station One should begin, followed by Station Two and so on.

3. **Administer the museum survey again. (Optional)**
   After all the groups have presented their exhibits, have students take their seats and get No. 2 pencils. **Note:** If you run out of time today, you may administer the survey tomorrow.

Important

For fastest results, please return the computer scanning cards from the museum survey directly to: NEED Processing Center, 1000 South Street, Lafeyette, IN 47901. You will receive your results within three to four weeks.

Key to Museum Survey

1. D	2. B	3. D	4. N/A	5. A	6. A
7. A	8. B	9. B	10. N/A	11. N/A	12. B

The Museum of Solid Waste and Energy Survey

Directions: Choose the letter of the response that answers the question or best reflects your own opinion. Choose "I Don't Know" if you have absolutely no idea and cannot even make a good guess. Mark your response on the computer scanning card using a No. 2 pencil.

1. The major method of disposing of the nation's solid waste is by...
   A. Composting B. Recycling C. Burning D. Landfilling E. I Don't Know

2. By volume, which material accounts for 40 percent of the nation's solid waste, almost twice as much as the second leading solid waste material?
   A. Plastic B. Paper C. Glass D. Metals E. I Don't Know

3. Source reduction means reducing the amount of waste we produce in the first place. Which of the following products have manufacturers targeted for most of their source reduction efforts?
   A. Food products
   B. Non-durable goods (clothing, disposable diapers, etc.)
   C. Durable goods (washing machines, toasters, etc.)
   D. Containers & Packaging
   E. I Don't Know

4. Laws should be passed requiring people to recycle so that the level of recycling can increase.
   A. Strongly Agree B. Agree C. Disagree D. Strongly Disagree E. Undecided

5. In a closed-looped recycling system, a product is...
   A. made into the same product.
   B. made into a different product.
   C. used as an energy source to make the same product.
   D. landfilled after one use.
   E. I Don't Know

6. Containers made from which of the following materials are coded to help recyclers in sorting.
   A. Plastics B. Glass C. Paper D. All Three E. I Don't Know

7. Waste materials are not equally valuable. Which of the following materials is the most valuable to recycle?
   A. Aluminum B. Steel C. Plastic D. Glass E. I Don't Know

8. Taking manufacture, transportation, and packaging into account, which of the following single-serve beverage containers is most energy-efficient?
   A. Aluminum Can B. Juice Box C. Glass Bottle D. Plastic Bottle E. I Don't Know

9. When biodegradable garbage is buried in a landfill, the garbage degrades (rots)...
   A. very quickly B. very slowly C. stays the same D. I Don't Know

10. Waste-to-energy plants burn garbage and use the heat energy to make electricity. Waste-to-energy plants produce some airborne pollutants, but they also reduce the amount of waste to be landfilled. Do you think the nation should build more waste-to-energy plants?
    A. Strongly Agree B. Agree C. Disagree D. Strongly Disagree E. Undecided

11. If a new landfill was needed in your area, how would you feel? I would...
    A. actively work to support its construction.
    B. support its construction but remain silent.
    C. oppose its construction but remain silent.
    D. actively oppose its construction.
    E. Undecided

12. When a photodegradable plastic is exposed to sunlight, the strength of the plastic...
    A. increases B. decreases C. stays the same D. I Don't Know

Survey and tabulation sponsored by Ronald McDonald Children's Charities.

Museum Backgrounders

The Museum of Solid Waste and Energy

Station 1 — Introduction to Solid Waste

Please Take out the Garbage!

You might think you have little in common with the typical young person of 2,000, 500, or even 100 years ago. But odds have it that both you and your ancient counterpart have heard the same request from a parent. "*Please take out the garbage!*"

Deciding what to do with garbage is not a new problem. People have wrestled with the trash problem ever since they left their nomadic ways behind some 10,000 years ago. The Greek city state of Athens opened the first municipal dump one mile from the city's gates over 2,500 years ago.

During the Middle Ages, European city dwellers threw their garbage out the door and onto the street. The people of the time didn't understand that many diseases are caused by filthy environmental conditions.

Then, in the late 1700s, a report in England finally linked disease to unsanitary waste disposal. The "age of sanitation" was launched. Cities began collecting waste to get it off the streets and out of public waterways. By the late 1800s, Europeans were even burning their waste and using the energy from it to produce electricity.

The situation was a little different on this side of the Atlantic. To the early colonists, America offered a seemingly endless supply of land and natural resources. So when dumping on city streets became intolerable, they simply took their waste to a dump outside town, using the spot until it was filled before moving on to the next dump.

As America's population grew and people left the farms for life in the city, the amount of waste increased. But the method of getting rid of the waste did not; we continued to dump it. Today, about 66 percent of our garbage is hauled off and buried in sanitary landfills.

Garbage by Any Other Name

People who study garbage use the term **municipal solid waste** (called MSW, for short) to describe our trash.

Municipal solid waste is the food you didn't eat for dinner, the old shoes you threw out, the empty jar of peanut butter, or the wrapper from your candy bar.

Garbage Timeline

500 B.C.	First city dump opened in Athens, Greece.
1388	English Parliament bans waste disposal in public waterways and ditches.
1400	Garbage piles up so high outside Paris gates that it interferes with the city defenses.
1690	Paper is made from recycled fibers at a mill near Philadelphia.
1842	A report in England links disease to filthy environmental conditions.
1874	In Nottingham, England, the "destructor" burns garbage and produces electricity. Ten years later, the first American incinerator opens in New York.
1900s	Pigs are use to help get rid of garbage in several cities. One expert said 75 pigs could consume 1 ton of garbage a day.
1904	First major aluminum recycling plants open in US.
1920s	Landfilling becomes most popular way to get rid of garbage.
1959	The first guide to sanitary landfilling is published.
1968	Congress passes the first set of solid waste management laws.
1987	A garbage barge circles Long Island after 6 states refuse to accept its waste for landfilling. The new garbage "crisis" erupts.

What Kind of Garbage Is This, Anyway?

Municipal solid waste is "regular" garbage that comes from homes, businesses, and schools. Municipal solid waste does not include construction waste, industrial waste, or sewage waste. Municipal solid waste can be classified in one of two ways:

- **Material**—what the waste was made from. Waste may be plastic, paper, metal, rubber, food waste, or yard waste. A plastic toy and a plastic yogurt carton would be in the same *materials* category because they are both made of plastic.
- **Product**—what the waste was used for originally. The waste may be an old potato chip bag, a worn-out shoe, or a broken toy. A plastic beverage container and an aluminum beverage container would be in the same *product* category because they are both used as containers.

More About Waste

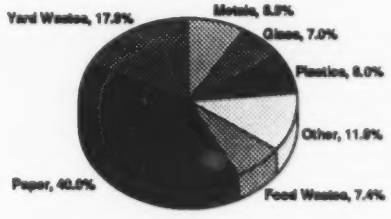
Which material do you think makes up most of the municipal solid waste in this country? Paper? Plastics? Metals?

If you said plastics are number one, then you agree with most Americans on this question. But you are also wrong. The correct answer is paper. By weight, paper accounts for a whopping 40 percent of the municipal solid waste stream. Plastics account for eight percent by weight.

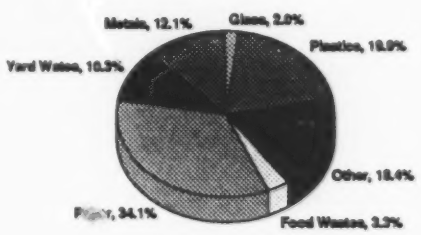
Sometimes people who study garbage find it more useful to know what waste was used for, instead of what it was made from. They put waste in one of five *product* categories.

- **Containers/Packaging:** This includes cans, jars, bags, bottles, boxes, and wrapping materials. Containers and packaging form the biggest product category.
- **Nondurable consumer goods:** These goods are called nondurable because they are not meant to last a long time. This category includes many paper products such as newspapers, magazines, and paper towels. This category also includes clothing and disposable dinner plates.
- **Durable consumer goods:** The goods in this category are called durable because they are meant to last a long time. This category is made up of many bulky and oversized items like washing machines, furniture, and rubber tires.
- **Yard wastes:** This category is made up mostly of grass clippings, but it also includes dead plants, branches, and even dirt!
- **Food wastes:** This is what you didn't eat for dinner, or what became a mysterious artifact in the bottom of your refrigerator.

Waste Materials by Weight, 1988



Waste Materials by Volume, 1988



Source: Environmental Protection Agency.

Weight v. Volume—It's All in How You Measure It

Until 1990, government reports always tabulated the amount of waste produced in this country by one measure—weight. People use weight to measure MSW because it is the most accurate measurement available. After all, the weight of the waste trucked to landfills is the same as the weight of the waste buried in landfills.

As landfill space shrinks in this country, though, the amount of space, or the *volume*, something takes up in a landfill may be more important than how much it weighs.

As one researcher put it, "landfills don't close because they're overweight; they close because they have reached their volume capacity."

As a case in point, let's look at the amount of container and packaging waste that is produced in the U.S. On the one hand, studies tell us that the total weight of containers and packaging in the solid waste stream has decreased in recent years.

But if you take one look at the products lining America's grocery store shelves, you get a very different story!

Are there really fewer containers and less packaging as studies suggest? What is really happening?

The explanation is simple. Manufacturers are switching to lightweight aluminum and plastic containers, replacing heavier steel and glass containers. There aren't fewer containers on America's grocery store shelves, they just weigh less.

That's great, but do these lightweight containers take up less space in a landfill? Not ordinarily.

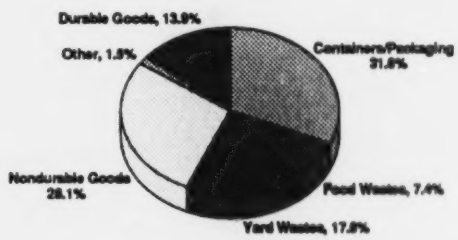
Studies show a plastic ketchup bottle takes up more space in a landfill than a glass ketchup bottle. So a better question may be whether the *volume* of containers and packaging has decreased in recent years. And the answer to that question is no.

So why would a plastic ketchup bottle take up more space in a landfill than a glass ketchup bottle?

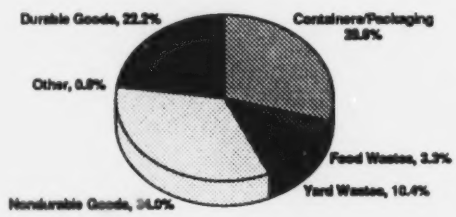
Heavy bulldozers crush and compact landfill waste and then bury it under layers of clay and topsoil. Some waste materials can be compressed more than others. Yard and food waste, which contain a lot of water, become very compact in a landfill. Yard waste is 17.6 percent of MSW by weight, but only 10.3 percent by volume.

Our glass ketchup bottle smashes into fine pieces, taking up less space than the plastic bottle, which squashes down but probably remains whole.

Waste Products by Weight, 1988



Waste Products by Volume, 1988

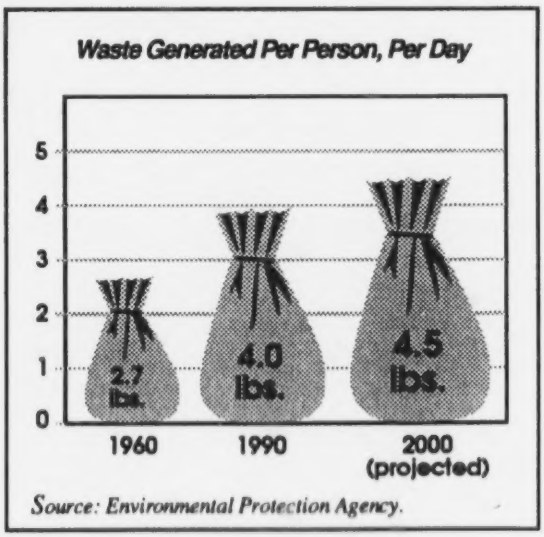


Source: Environmental Protection Agency.

A Mounting Problem

Americans are producing more waste with each passing year. Over the past 30 years, the waste produced in this country has more than doubled, from 88 million tons in 1960 to nearly 193 million tons in 1990. Some of this increase is linked to U.S. population growth. After all, there are more Americans today than there were in 1960. But that doesn't account for the whole increase.

Our lifestyle has changed. People can buy more convenience items and more disposables, and they can choose from a wider variety of products. Today the average American generates four pounds of trash every day. That's 1.3 pounds more trash than the average American produced in 1960. By 2000, the government predicts the average American will be throwing away even more trash, about 4.5 pounds every day.



Source: Environmental Protection Agency.

And the Answer Is...

How can we solve America's waste disposal problem? There is no single answer. Most experts agree that we should use four steps to manage our waste problem and in this order:

1

Source Reduction

Reducing the amount of waste we produce in the first place.

Example—using less aluminum to make an aluminum can.

2

Recycling

Using old products to make new products.

Example—Using old newspapers to make egg cartons.

3

Waste-to-Energy

Burning trash to produce steam and electricity.

4

Landfilling

Burying waste when it can not (or should not) be burned or recycled.

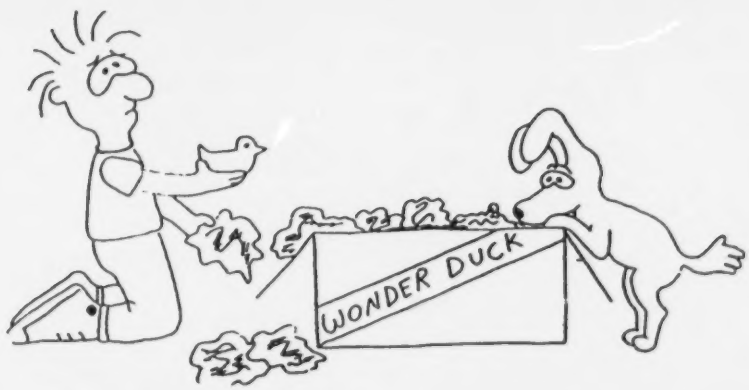
The Museum of Solid Waste and Energy

Station 2 — Source Reduction

Another Day, Another 4 lbs. of Garbage

"Got up, got out of bed, dragged a comb across my head," the song goes. But what if a couple of comb teeth break off? Why, just throw the comb out and buy a new one. Then it's downstairs for breakfast. Perhaps you'll have a microwavable pancake breakfast with a throwaway tray. Or maybe you'll take along an individually-wrapped pastry and a juice-in-a-box for breakfast on the school bus.

Rrring! The school bell signals the start of school. First period English class begins, and you pull out your disposable pen and throwaway spiral notebook. Later it's time for lunch in the school cafeteria. You finish eating today's mystery meat and toss the disposable utensils, cups, and plates in the trash. After school you go shopping for the latest CD from your favorite rock artist. Maybe you noticed that the package the CD comes in is twice the size as the CD itself.



And so the day goes.

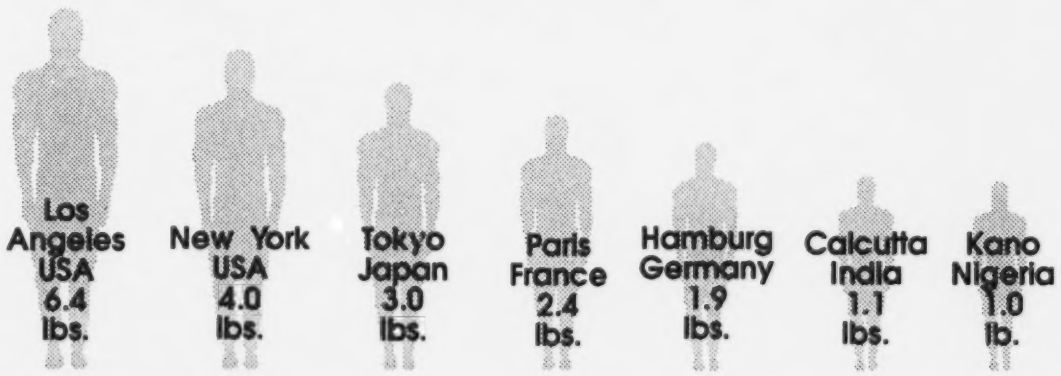
Imagine this scenario played out every day by young Americans across the country. You and every American adult and child generate four pounds of waste every day of your life, more waste than citizens of any other country.

America seemed to have an "out of sight, out of mind" attitude about its waste until 1987 when nightly newscasts told the saga of the New York garbage barge circling Long Island with no place to unload its cargo.

Since then, America's attitude has changed, but waste has continued to mount. Landfill space is shrinking so rapidly that the landfills in 25 states will be full within the next ten years.

Waste Generation for Selected World Cities

(Pounds per person, per day.)


Los Angeles USA 6.4 lbs.
New York USA 4.0 lbs.
Tokyo Japan 3.0 lbs.
Paris France 2.4 lbs.
Hamburg Germany 1.9 lbs.
Calcutta India 1.1 lbs.
Kano Nigeria 1.0 lb.

Source: National Solid Waste Management Association.

What can we do to head off a potential garbage crisis?

Reducing Waste At the Start

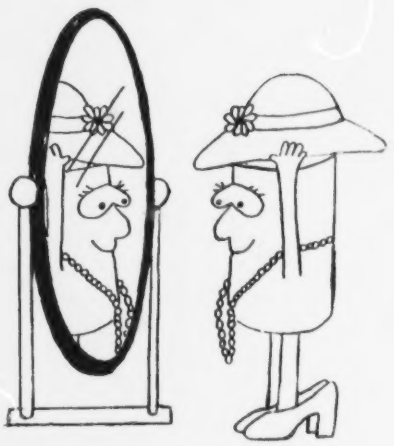
Source reduction should be the first step in any waste management program. Source reduction means reducing the amount of material that enters the waste stream in the first place.

Common sense tells us that reducing the amount of waste we produce is the easiest way to solve America's mounting garbage problem. It avoids disposal and pollution problems right from the start, and it conserves natural resources and energy. Reducing waste at the beginning means there will be less waste to be recycled, burned, or landfilled later.

All Wrapped Up and No Place to Go

Packaging—the stuff we wrap or box consumer products in—has become the target of most source reduction efforts. Why? Because packaging is the single largest product in the waste stream.

Just look at the products lining grocery store shelves. Bread is wrapped in a plastic bag. Soup comes in a can. Cookies are neatly arranged on plastic trays that are then slipped inside paper bags. Six bottles of cola are wrapped together in plastic. Sometimes even apples are arranged on a cardboard or plastic foam tray and then wrapped in plastic.



Dieting Manufacturers Are Watching Their Wastes!

There is some good news, though. The Environmental Protection Agency—an agency of the federal government—reports that manufacturers are reducing the amount of waste in consumer products.

Companies that make consumer products are doing a couple of things to reduce waste. For one, they are redesigning products so they need less packaging. Consumers can now buy fabric softener concentrate in small paperboard cartons, instead of buying big plastic jugs every time. Concentrated products can reduce packaging by 75 percent.

Second, companies are using fewer materials to package products. Kodak is now selling film in the familiar black canister, but minus the paper carton. And virtually all manufacturers are using less materials to make bottles, jars, and cans, something that has probably gone unnoticed by most Americans.

The soft drink industry, for example, is making thinner bottles and cans. Today's two-liter plastic bottles are 20 percent lighter than when they were introduced in 1977. And aluminum cans are 35 percent lighter and glass jars are 43 percent lighter than they were in 1970.

Other industries are doing their part too. Disposable diapers are thinner than ever before, keeping babies dry with half as much material. Half-gallon ice cream cartons now weigh 30 percent less after manufacturers changed the carton's materials and design. And when McDonald's made its drinking straws 20 percent lighter, it eliminated one million pounds of solid waste per year.

The benefit of all these efforts is less waste. Less waste to be landfilled, recycled, or burned.

As one person put it, "The list is as long as the supermarket aisle."

Yet packaging serves many useful purposes. The bread wrapper keeps the bread fresh and clean. The soup can keeps the soup fresh for months on grocery store shelves. The cookie tray keeps the cookies from getting crushed. The plastic wrapping around soft drinks makes it easy to grasp six bottles of cola in one hand. The wrapped apples mean less time selecting food.

Without a doubt, packaging provides a convenient and sanitary way to store and transport food and other products.

Sometimes, though, packaging is more a marketing ploy—the purpose being to make the product look bigger and better than its competitors. This packaging does not come free. Americans pay a price for all the wrapping and glitter. Eleven percent. That means 11 percent of the money ($1 in every $11) your family spends on groceries winds up in the garbage bin!

And it had better be a big garbage bin. Packaging comprises almost 32 percent of the municipal solid waste stream by weight, or 30 percent by volume.

Big News for Little Boxes

A lot of people love the convenience of drink boxes, but they worry about what happens to the boxes when they finish drinking their milk or juice. Maine even went so far as to ban drink boxes in the state after environmentalists and others voiced concerns about the disposal of these little boxes.

But waste disposal is only one piece of the solid waste puzzle. And it's not the first piece either.

The EPA says we should work on reducing the amount of waste that enters the waste stream first, so we have less recycling, burning, and landfilling to do later.

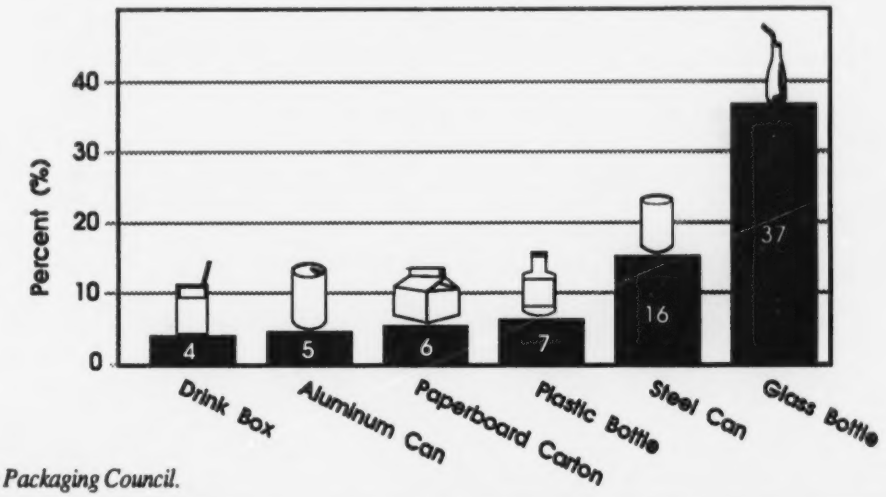
One way companies can reduce waste is by using less packaging to bring a product to market. This is where drink boxes beat the competition.

Drink boxes use ultra-thin layers of paper, plastic, and aluminum foil to make a strong, but extremely lightweight, beverage container. A typical drink box is four percent packaging by weight and 96 percent beverage. A single-serve glass bottle is more than 30 percent packaging by weight and less than 70 percent beverage.

Drink boxes reduce waste because they use less materials to begin with than other types of single-serve beverage containers. And now they're being recycled too. Pilot drink box recycling programs are underway in 12 states.

How Much is Packaging?

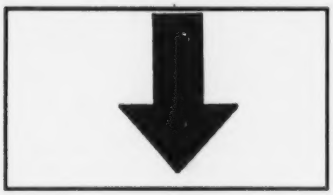
Weight of Single-Serve Packages as a Percent of Total Contents Plus Package



Source: Aseptic Packaging Council.

What You Can Do

You can help reduce waste at home by learning basic waste-saving habits. You can buy products that come in concentrated forms or products that use minimal packaging. And you can reuse, repair, recycle, or compost products that would otherwise be thrown away.



Reduce

- Buy the largest size package and products that do more than one thing—for example, shampoos that include conditioners.
- Buy concentrated products or compact packages, such as frozen juices and fabric softeners you mix with water at home.
- Look for products with minimal packaging. You will be using fewer natural resources, and you'll have less to throw away.
- Leave grass clippings on the ground instead of bagging them when you mow your lawn. Grass clipping decompose quickly, adding nutrients to the soil.

Reuse

- Buy reusable products such as rechargeable batteries.
- Pass on magazines, catalogues, and books to neighbors, hospitals, schools, and nursing homes.
- Reuse plastic or glass containers for food storage, nails, tacks, and so on.
- Reuse plastic shopping bags, boxes, and lumber.
- Reuse wrapping paper, gift bags, and bows. Use the Sunday comics for wrapping children's birthday presents.

Repair

- Try to repair before you consider replacement of lawn mowers, tools, vacuum cleaners, and TVs.
- Donate items you can't repair to local charities or vocational schools.

Recycle

- Shop for items that are recyclable or are made from recycled materials.
- Recycle newspapers, plastics, glass, and cans.

Compost

- Compost yard and kitchen waste. Compost makes an excellent fertilizer and improves the soil.

The Museum of Solid Waste and Energy

Station 3 — Introduction to Recycling

What Is Recycling?

Recycling means to use something again. Newspapers can be used to make new newspapers. Aluminum cans can be used to make new aluminum cans. Glass jars can be used to make new glass jars. And so on.

There are several reasons why recycling makes sense. Let's take a look at them.

Recycling Saves Landfill Space.
Americans are producing more waste with each passing year, most of which is hauled off and buried in landfills. What's wrong with that? Well, we are running out of landfill space—and fast! Besides, it's expensive and usually controversial to dig new landfills (or to build new incinerators, for that matter). Recycling is one way to reduce the amount of waste that is landfilled.

Recycling Reduces the Cost of Waste Disposal.
Getting rid of trash isn't a free proposition. Garbage trucks must *pay* to dump their waste at a landfill. The payment is called a "tipping fee," and it is based on the weight or volume of the garbage.

Tipping fees vary from town to town, but generally tipping fees are going up. In some East Coast communities tipping fees may be $40 per cubic yard or more.

Recycling reduces landfill costs because less waste is landfilled.

Recycling Saves Energy.
It almost always takes less energy to make a product from recycled materials than it does to make it from new materials.

Using recycled aluminum scrap to make new aluminum cans, for example, uses 95 percent less energy than making aluminum cans from bauxite ore, the raw material used to make aluminum.

One exception to the recycling-always-saves-energy rule is plastics. Sometimes it takes more energy to recycle plastics than it does to use all new materials.

Recycling Saves Natural Resources.
Natural resources are riches provided courtesy of Mother Nature. Natural resources include land, plants, minerals, and water. By using materials more than once, we conserve natural resources.

In the case of paper, recycling saves trees and water. Making a ton of paper from recycled stock saves as many as 17 trees and uses 50 percent less water.

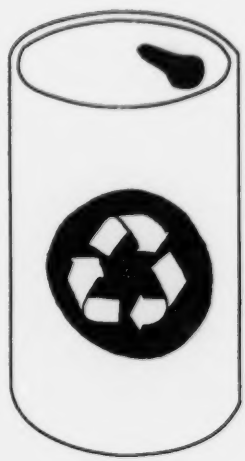
Recycling Reduces Air and Water Pollution.
Remember those aluminum cans? Using aluminum scrap instead of bauxite ore to make new aluminum products cuts air and water pollution by 96 percent! If you want to do something for the environment, recycle those aluminum cans!

Closed Loop Recycling

Closed loop recycling is making an old product into the same thing again. It means turning old aluminum cans into new aluminum cans, or old glass jars into new glass jars.

Turning plastic milk jugs into flower pots is *not* closed loop recycling because a different product is made.

Closed loop recycling is ideal because there is already a market for the recycled product; manufacturers don't have to hope that people will buy aluminum cans, they know people will. That may not be true for recycled plastic flower pots, though.



There Must Be 50 Ways to Leave Your Recyclables

Okay, so maybe the United States should be recycling more of its waste. But even the experts disagree on the best way to go about it. Should communities pick up residents' recyclables? Or is this practice too expensive for overstretched city budgets? And does it deprive the traditional picker-uppers (Boy Scouts, high school groups) the opportunity to raise money for their clubs? Let's take a look at some ways recyclables can be collected.

Curbside Collections

Residents leave their recyclables at the curb (or in some other designated place) where regular trash is picked up. Communities may require residents to sort their recyclables—such as aluminum cans, newspapers, glass—into separate containers or they may be "mingled" together. Curbside collection programs boast the highest recycling rates. Some experts say curbside recycling nationwide could reduce the volume of solid waste by 15 to 25 percent.

Drop-Off Centers

People bring their recyclables to these collection centers. This saves the community the cost of curbside collection but relies on willing residents to drive to the center for the little or no reimbursement given for their recyclables.

Reverse Vending Machines

These machines accept used beverage containers and reimburse the depositor on the spot. Reverse vending machines are convenient because they are usually located inside or outside grocery stores.

Deposits

Several states impose a 5 or 10-cent deposit on returnable bottles and cans. Consumers get their deposits back when they return the containers to the store for recycling. These so-called "bottle-bill" states originally passed deposit laws to combat litter problems. Now they are one step ahead of the game. Deposits help solid waste disposal problems too.

Pick-Up by Volunteers

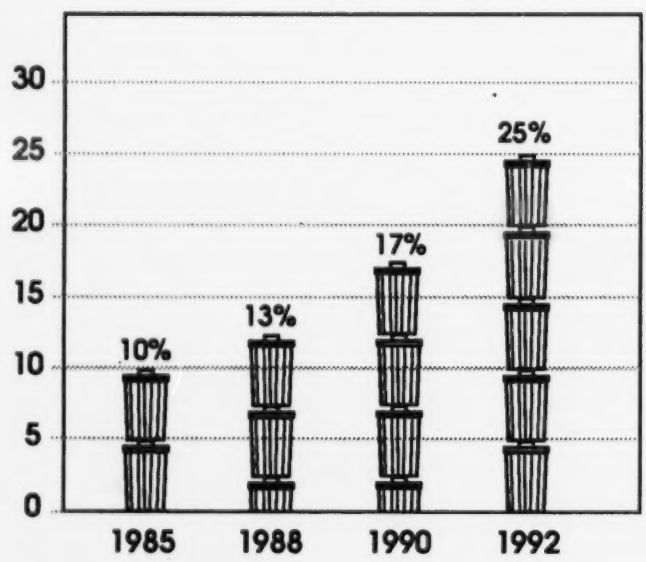
This is recycling the old-fashioned way. Community groups, such as church groups and the Boy Scouts, collect recyclables to raise money for their clubs. These groups usually just pick up aluminum and newspapers because their scrap value is higher than other recyclables.

Recycling Fever

Recycling programs are growing across the United States. The media and the rejuvenated environmental movement have focused attention on our mounting waste problem. Now recycling has become the "in" thing to do.

Americans recycled just 10 percent of their waste in 1985; 13 percent in 1988, and 17 percent in 1990. A good improvement! (By the way, it takes time to collect information about recycling programs, so 1990 is the latest year for which statistics are available.)

Could we do more? The Environmental Protection Agency—an agency of the federal government—thinks so. The EPA has set a national target for recycling. It wants Americans to be recycling 25 percent of their waste by 1992.



Recylced trash as percentage of total trash. The EPA has set a 25% recycling goal for 1992. Source: Environmental Protection Agency.

The Keys to Success

No one who is serious about solving America's waste disposal problem questions the importance of recycling. Yet the experts debate whether Americans should just be asked to recycle their waste (a *voluntary* program), or whether they should be required by law to recycle their waste (a *mandatory* program).

Mandatory Recycling

Some communities have passed laws or ordinances mandating that citizens recycle at least some of their trash. Typically, residents in these communities separate their newspaper, aluminum, glass, and other recyclables from the rest of their trash. (Other communities may only require that newspapers be separated for recycling.) Residents who do not comply with local recycling laws may be fined, or their trash may simply not be picked up.

Voluntary Recycling

Under a voluntary recycling program, residents are encouraged to recycle their waste, but they are not required to do so. Residents who choose not to recycle their waste are not fined or penalized in any way.

Are mandatory programs better at recovering recyclables than voluntary programs? The statistics show they are better. In voluntary programs, about one-third (33%) of the community will recycle. In mandatory programs, about one-half (50%) of the community will recycle.

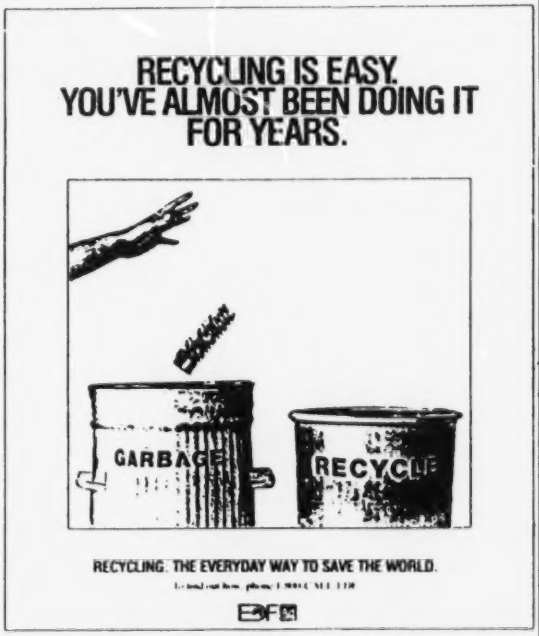
That brings up another question. Why don't more people recycle, say 80 to 90 percent, under mandatory recycling programs? What about those laws?

The answer is simple. Enforcing these laws is almost impractical. It means going from trash can to trash can to find out who is recycling and who is not.

So far, New York City, which has 1.5 million people under its recycling belt, is the only big city to enforce its recycling program. The city's Sanitation Department has assigned 133 officers the task of rummaging through residents' trash. The officers can issue $25 tickets to noncomplying "waste bandits."

(Interestingly enough, the city has hired only 46 people to educate New Yorkers about recycling, compared to the 133 it has hired to enforce the program.)

In any case, new studies suggest that successful recycling programs—whether mandatory or voluntary—are those which make it easy for people to recycle. The most successful recycling programs provide residents with special containers for sorting their waste and collect the recyclables weekly along with the rest of the trash. Ease and convenience are the keys to success.



A recycling poster from the Environmental Defense Fund and the Ad Council.

When Is Recycling Not Recycling?

Recycling always makes sense, right? No, not always.

Sure, recycling sounds great, but recycling costs money and uses energy too. Recyclables have to be collected, sorted, shipped to manufacturing plants, and then made into new products.

Collecting recyclables is only the first part of the story. We can be good citizens and take our trash to recycling centers or set it at curbside for collection But if nobody wants to buy the recyclables, we haven't accomplished much.

In other words, somebody has to want to buy old newspapers because it is cheaper to use them to make a new paper product than it is to use virgin paper stock.

What happens when nobody wants to buy recyclables? The East Coast recently experienced this problem when there was a glut of old newspapers. Communities on the East Coast collected newspapers for recycling, but nobody wanted to buy them. The newspapers just sat around in warehouses waiting to get a second life as useful products.

That is not recycling. Recycling means to make something old into something new. Collection is only one step.

There is good news for the East Coast though. The newspaper glut will disappear as consumers and manufacturers begin to demand recycled paper products. Fortunately, this is beginning to happen.

By the way, even though there is a flood of old newsprint on the East Coast, there is a shortage of white office paper. Recyclers cannot get enough of this stuff.

Recycling Guide

Material	What Can Be Recycled	What Can't Be Recycled	How To
Glass	Jars, bottles Clear, green, amber	Light bulbs, dishes, Pyrex, crystal	Rinse, remove lids. Separate by color. Labels may stay on.
Paper	Newspapers, boxes, egg cartons, phone books, white office paper	Waxed, glued, plastic, or foil coated	Keep clean and dry.
Aluminum	All aluminum—cans, pie pans, foil wrap, old windows, lawn furniture	All recyclable. (Aluminum *does not* stick to a magnet.)	Rinse and crush.
Steel	Steel (tin) food and beverage cans, cast iron, sheet metal	All recyclable. (Steel *does* stick to a magnet.)	Rinse, crush if possible. Labels may stay on.
Plastics	All plastics (Usually milk jugs and 2-liter bottles.)	(Check with your recycler.)	Rinse, remove lids. Labels may stay on.

The Museum of Solid Waste and Energy

Station 4 — Recycling Plastics

It's Not Plastic, It's Genuine Vinyl!

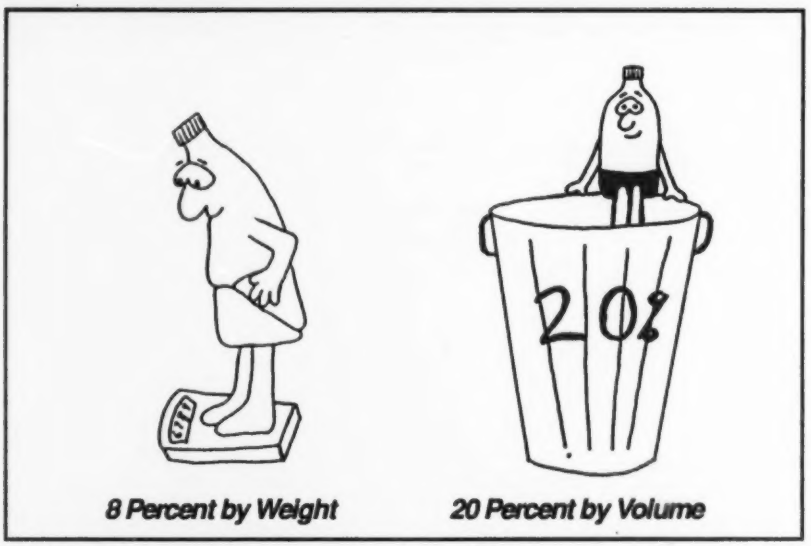
Americans seem to have a love-hate affair with plastic. We look down upon plastic imitations of natural products and fibers. They are cheap, we say. Yet we are using plastic products more than ever before. We wrap our food in plastic, drink coffee from Styrofoam® cups, wear plastic clothes made from man-made fibers like nylon, polyester, and rayon, and we even buy our plastic things with plastic credit cards!

What Is Plastic?

Plastic is a versatile product. Plastic can be flexible or rigid; transparent or opaque. It can look like leather, wood, or silk. It can be made into toys or heart valves. Altogether there are over 10,000 plastic formulations.

The basic raw material for plastic is petroleum or natural gas. These fossil fuels are sometimes combined with other elements, such as oxygen or chlorine, to make different types of plastic.

Plastics are not the waste and energy culprits that some people think they are. Plastics are really very energy efficient. It takes less energy to manufacture a plastic ketchup bottle than it does a glass ketchup bottle. And since plastics are lightweight, it takes less energy to transport a truckload of plastic ketchup bottles than a truckload of glass ketchup bottles.



Weight does not always equal volume. Plastics are eight percent of America's municipal solid waste by weight. But they are 20 percent by volume. Source: Environmental Protection Agency.

What Should We Do With Plastic Trash?

Is plastic trash choking the Earth with Styrofoam® cups and fast-food plates? No, not really. That's just another popular misconception.

By weight, plastics comprise about eight percent of America's municipal solid waste. In comparison, paper makes up about 40 percent of municipal solid waste.

Of course, plastics are generally very lightweight. When plastics are buried in a landfill, they occupy about 20 percent of the space.

Landfilling plastics, though, is not always the best disposal method. There are two other alternatives: recycling and incineration.

These methods recover something of value from the plastic. Recycling recovers the raw material that can be used to make new plastic products. Incineration recovers the energy that can be used to make steam and electricity.

Landfilling does neither of these things. The value of landfilled plastic is buried forever.

Recycling Plastics

Recycling plastics is easy. First, you should learn what types of plastics can be recycled and only give the types of plastics asked for by your collector.

Resist the temptation to slip plastics into the recycling bin that recyclers don't want. Plastics have different formulations and should be sorted before they are recycled to make new products. (Mixed plastics can be recycled, but they are not as valuable as sorted plastics because the recycled plastic's physical proper-

ties, such as strength, may vary with each batch.)

Once you know what kinds of plastics your recycler wants, you should follow the "wash and squash" rule—rinse the container and squash it.

You may leave the paper labels on the container, but you should throw away the plastic caps. Plastic caps are usually made from a different type of plastic than the container and cannot be easily recycled.

Energy to Burn

Because plastics are made from fossil fuels, you can think of them as another form of stored energy. Pound for pound, plastics contain as much energy as petroleum or natural gas, and much more energy than other types of garbage. This makes plastic an ideal fuel for waste-to-energy plants.

Waste-to-energy plants burn garbage and use the heat energy released during combustion to make steam or electricity. In other words, they turn garbage into useful energy.

So, should we burn plastics or recycle them? It depends.

Sometimes it takes more energy to make a product from recycled plastics than it does to make it from all-new materials. If that's the case, it makes more sense to burn the plastics at a waste-to-energy plant than to recycle them.

Burning plastics can supply an abundant amount of energy, while reducing the cost of waste disposal and saving landfill space.

Plastics Recycling Code

The Society of the Plastics Industry introduced a system for coding rigid plastics packaging and containers in 1988. The codes help homeowners and recycling plants sort plastics that would otherwise be used once and then thrown away. The codes do not apply to flexible plastics packaging or to non-disposable plastics products, such as plastic toys.

The code symbol is three "chasing" arrows with a number on the inside and letters on the bottom. It resembles the recycling symbol used for paper products. Plastics are coded according to the type of plastic resin they are made from. There are seven codes.

When you are home, take a look at plastic containers in your kitchen and bathroom and see how many plastics codes you can find.

PETE—Polyethylene Terephthalate. Two-liter beverage bottles, mouthwash bottles, boil-in-bag pouches.

HDPE—High Density Polyethylene. Milk jugs, trash bags, detergent bottles.

V—Vinyl (sometimes seen as PVC, for polyvinyl chloride). Cooking oil bottles, packaging around meat.

LDPE—Low Density Polyethylene. Grocery bags, produce bags, food wrap, bread bags.

PP—Polypropylene. Yogurt containers, shampoo bottles, straws, margarine tubs.

PS—Polystyrene. Hot beverage cups, fast-food clamshells, egg cartons, meat trays.

Other. All other types of plastics or packaging made from more than one type of plastic.

Plastics to Profits

What happens to plastic after you discard it for recycling? Typically, the used plastic is shipped to a recycling plant. A recycling plant uses seven steps to turn plastic trash into plastic profits:*

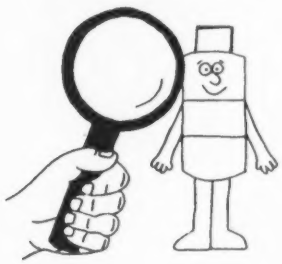
1. **Inspection**. Workers inspect the plastic for contaminants like rock and glass, and for plastics that the plant cannot recycle.
2. **Chopping and Washing**. The plastic is washed and chopped into flakes.
3. **Flotation Tank**. If mixed plastics are being recycled, they are sorted in a flotation tank, where some types of plastic sink and others float.
4. **Drying**. The plastic flakes are dried in a tumble dryer.
5. **Melting**. The dried flakes are fed into an extruder, where heat and pressure melt the plastic. Different types of plastics melt at different temperatures.
6. **Filtering**. The molten plastic is forced through a fine screen to remove any contaminants that slipped through the washing process The molten plastic is then formed into strands.
7. **Pelletizing**. The strands are cooled in water and then chopped into uniform pellets.

Manufacturing companies buy the plastic pellets from recyclers to make new products. Proctor & Gamble puts its liquid *Spic 'n Span* in a bottle made completely from recycled plastic. Lever Brothers uses some recycled plastic to bottle its *Wisk*, *All*, and *Snuggle* laundry products.

Recycled plastics also can be made into flower pots, lumber, carpeting, and stuffing for ski jackets.

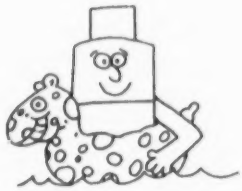
**From* Garbage *magazine, January/February 1991.*

1. Inspection

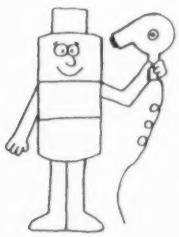


2. Chopping & Washing

3. Flotation Tank

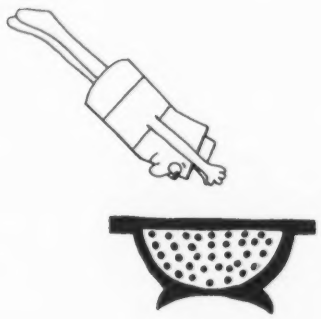


4. Drying



5. Melting

6. Filtering



7. Pelletizing

Paper or Plastic?

A paper cup or a plastic cup? Suddenly, your choice in cup has become a measure of your environmental correctness. Should you choose paper cups over plastic cups since the paper cups are made from natural wood products and will degrade? Maybe not.

A recent study by Canadian scientist Martin Hocking shows that making a paper cup uses as much petroleum or natural gas as a polystyrene cup. Plus, the paper cup uses wood pulp!

The Canadian study said "the paper cup consumes 12 times as much steam, 36 times as much electricity, and twice as much cooling water as the plastic cup."

And because the paper cup uses more raw materials and energy, it also costs 2.5 times more than the plastic cup.

But the paper cup will degrade, you say. Again, maybe not. Modern landfills are designed to inhibit degradation so that toxic wastes do not seep into the surrounding soil and groundwater.

What about Degradable Plastics?

Degrade is another word for rot. It's nature's way of getting rid of dead plants and animals or the things made from them.

Of course, plastics are man-made materials, but scientists have figured out two ways to make plastics degrade: biodegradation and photodegradation.

Biodegradable plastics are made with five percent corn starch or vegetable oil. The idea is that hungry bacteria will devour the starch or oil in the plastic, causing the plastic to disintegrate into a fine dust. That is the idea, but does it really work?

No, say both environmentalists and plastics manufacturers. Nothing degrades quickly in a modern landfill, not even organic wastes like paper and food scraps, so there is no reason to think that the corn starch in biodegradable plastics will disappear overnight either. Modern landfills are designed to inhibit degradation, not promote it. The idea is to keep wastes in, so landfill contaminants do not seep into the surrounding environment. Biodegradable plastics also cannot be recycled because the starch or oil additive would compromise the quality of recycled plastics.

Photodegradable plastics are a different animal. They use no organic additives. They are made with a special type of plastic that breaks down and becomes brittle in the presence of sunlight. Of course, that means photodegradable plastics do not break down when they are covered by leaves or snow, or when they are buried in a landfill.

The maker of the plastic six-ring carrier that is used to attach six cans of soda, beer, and other beverages, says its photodegradable carrier loses 75 percent of its strength when exposed to sunlight after just a few days, and totally disintegrates within a matter of weeks. This means if an animal were to become entangled in the six-ring carrier, it could rip through the weakened pack to free itself. Since photodegradable plastics contain no organic additives, they also can be recycled, unlike their biodegradable cousins.

The Museum of Solid Waste and Energy

Station 5 — Recycling Metals

Introduction

This backgrounder will teach you about recycling two types of metals—aluminum and steel. Some other types of metals, like gold, silver, brass, and copper, are so valuable that you would never dream of throwing them away. So, they do not create a waste disposal problem. But aluminum and steel do. Americans use 100 million steel cans and 200 million aluminum beverage cans every day.

What should we do with metallic waste? Should we burn it in waste-to-energy plants? Landfill it? Recycle it?

After source reduction (using less aluminum to make a beverage can, for example), recycling is the best way to deal with aluminum and steel waste.

Burning metal trash in waste-to-energy plants is not the best option because, unlike paper and plastics, metals do not provide any energy. Instead, aluminum melts and steel just gets very hot. (Magnets can be used to collect steel scrap at waste-to-energy plants, though, and then the scrap can be shipped to steel plants for recycling.)

Landfilling is usually not a good alternative either. Aluminum, in particular, is so valuable as a scrap material that it simply does not make sense to bury it.

Recycling Aluminum

The ABCs of Aluminum

Like most metals, aluminum is an ore in its natural state. (An ore is a mineral that is mined for a valuable material which it contains—like a metal.) Bauxite, a reddish clay-like ore, is rich in aluminum compounds.

The tricky thing about aluminum—unlike copper, iron, and some other common metals—is it only exists in combination with other elements, usually oxygen. Combining with oxygen, aluminum forms an extremely hard material known as alumina.

To free the aluminum, the alumina must be "stripped" or "reduced" of its oxygen. This process is done at a reduction plant, or smelter. The alumina is put in large pots at the reduction plant where it is first dissolved in a molten salt. Then it is subjected to a powerful and continuous electric current to separate the aluminum and oxygen. Molten aluminum sinks to the bottom of the pots. The reduction process requires a tremendous amount of electrical energy.

That is precisely why recycling aluminum makes sense. It saves energy—a lot of energy. And, as you probably know, energy is expensive! Just take a look at your parents' electric bill, or note the price of a gallon of gasoline the next time you see a gas station.

Making a pound of aluminum from bauxite ore (a pound is about how much 28 aluminum beverage

cans weigh) takes 7.5 kilowatt-hours (kWh) of electricity and six pounds of coal to generate that electricity.

Making aluminum from recycled aluminum scrap, on the other hand, takes only five percent of the energy—just one-third kWh and just one-quarter pound of coal. Recycling two aluminum cans saves as much energy as the energy in one cup of gasoline.

That is also why old aluminum beverage containers and other used aluminum items have a high scrap value. Aluminum manufacturers save energy (and money!) by using recycled aluminum so they will pay you for your old cans—about a penny for every can.

Perhaps more so than any other type of garbage, putting aluminum in a landfill is like burying money.

How Old Cans Are Turned into New Cans

Okay, so you have done your part by taking your old aluminum cans to a recycling center or setting them at the curb for pick-up. What happens next?

The old aluminum cans are taken to an aluminum reclamation plant. The cans are shredded into popcorn size chips and fed into a melting furnace. The molten aluminum is gradually hardened into rectangular slabs, called ingots, and then formed into sheets.

Recycled aluminum cans are usually recycled back into new aluminum cans. This is called "closed-loop" recycling because the old cans are turned into the same thing again. Aluminum beverage containers can be recycled into new cans and put back onto store shelves within 90 days!

Aluminum also can be recycled over and over again. It does not wear out or loose quality. And it saves energy every time.

Aluminum Recycling Saves 95% of the Energy Used to Make All-New Aluminum...

One pound of aluminum from *all-new* materials uses:

- **7.5 kWh of electricity**
- **6 lbs. of coal**

One pound of aluminum from *recycled* scrap uses:

- **.33 kWh of electricity**
- **.25 lbs. of coal**

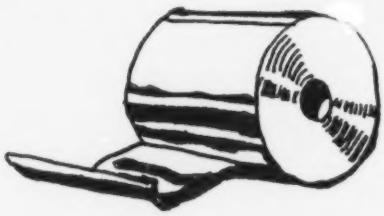
The Story of Aluminum Recycling...It's Worth Repeating

1. **You enjoy your favorite beverage in an aluminum can.**

2. **You are a good "sort." You put the aluminum can in a bag for recycling.**

3. **Recycling company takes the cans to a recycling plant. The aluminum is shredded and melted.**

4. **The molten aluminum is gradually hardened into ingot form.**



5. **Ingots are made into aluminum sheets or other desired forms.**

6. **The aluminum is made into new cans, and the cycle begins again.**

Recycling Steel

True or False. Steel is America's most recycled material.

The answer is true! Steel dominates the recycling mix because every year the steel industry recycles huge amounts of steel scrap from cars, appliances, and torn-down buildings and bridges. Today, all steel products are made with recycled steel.

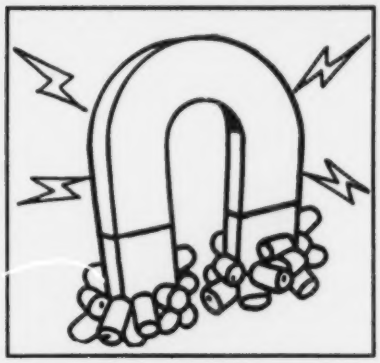
You can do your part at home by recycling steel cans. But, what's a steel can, you ask?

A steel can is the can your soup comes in, or your dog's food, or your mom's coffee, or the whip cream you squirt on top of an ice-cream sundae. In fact, about 90 percent of all food containers are made of steel.

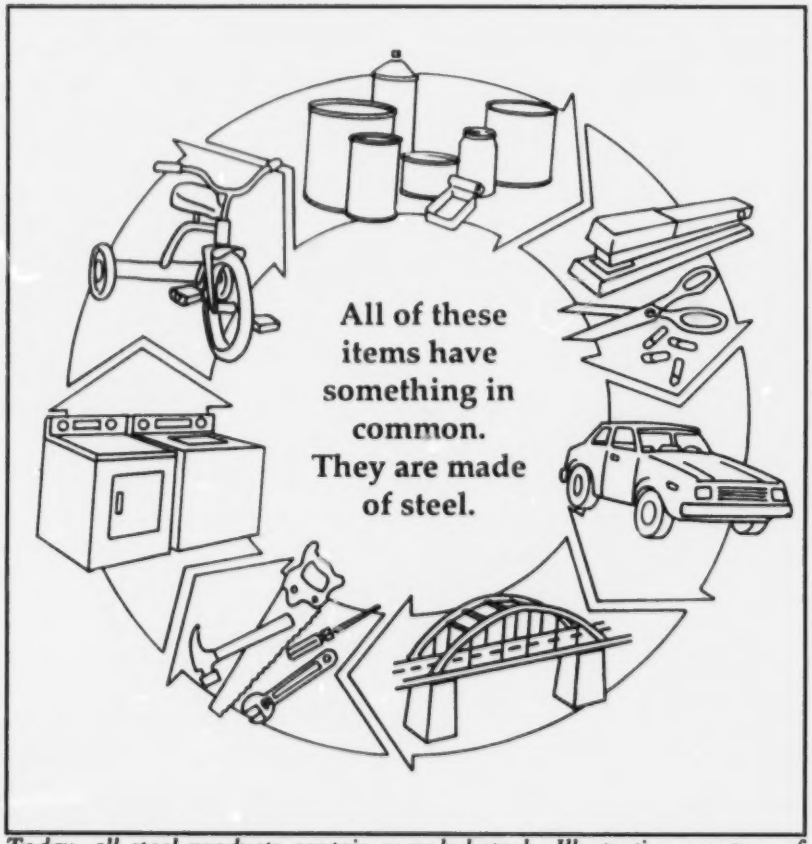
You have probably called the ordinary steel can a "tin" can all your life. Steel cans are commonly called tin cans because they are usually coated with a thin layer of tin. Tin is a natural element which stands up to the food sterilization methods which cook food in the can.

The ABCs of Steel

Steel and aluminum, which are both mined from ores, are made in a similar manner. The essential ingredient in steelmaking is iron ore. Iron ore is plentiful, but we cannot use it as it occurs in nature.



Unlike other recyclables, steel is attracted to a magnet. This property makes steel easy to separate from the rest of the solid waste stream and easy to recycle. Illustration courtesy of Steel Can Recycling Institute.



Today, all steel products contain recycled steel. Illustration courtesy of Steel Can Recycling Institute.

Iron is usually combined with oxygen, or with other elements, like carbon and sulfur. We have to smelt the iron ore—strip or reduce of its oxygen—to get to the iron.

It takes a great deal of energy to reduce iron oxides. (An oxide is a compound with oxygen and some other element.) The reduction takes place in a blast furnace where coal is burned. A chemical reaction takes place in the blast furnace, and the iron is freed from the oxygen. This free iron (called "pig" iron by steelmakers because it forms a pattern that looks like tiny piglets surrounding their mother) is used to make steel.

Steel recycling saves a lot of energy. It is much more energy efficient to use steel scrap to make steel than to mine the iron ore and then smelt it in a blast furnace. It takes about 75 percent less energy to make steel from recycled materials than it does from iron ore. That's why today's steel makers always use steel scrap to make new steel products.

How to Recycle Steel

Steel is probably the easiest material to separate from the rest of the waste stream. Steel cans are magnetic so magnetic belts can be used to separate steel cans from other recyclables. This method is much more efficient than the labor-intensive hand-sorting necessary with some other recyclables.

Recycling your used steel cans at home is easy too. All you need to do is rinse the cans. That's it. Years ago, scrap dealers asked people to remove the paper labels and the tops and bottoms from cans. This is no longer necessary.

If you're not sure whether a can is steel or aluminum, use a magnet to separate them. Steel will stick to the magnet; aluminum will not.

If you come across a can with a steel body and an aluminum top—called a bi-metal can—put the can with the steel recyclables. Steel recyclers can accept all types of steel cans, even those containing aluminum. Aluminum recyclers can only accept 100 percent aluminum cans.

After steel scrap is collected from homes, recycling centers, or waste-to-energy plants, it is shipped to one of the several types of companies that buy old steel—steel mills, iron and steel foundaries, ferrous scrap dealers, and detinners. (Detinners remove the layer of tin from old steel cans. Tin is valuable and can be sold.)

Steel can recycling follows almost the same recipe as aluminum can recycling. Steel cans, along with other steel scrap, are melted in a furnace and then poured into casters that continuously roll and flatten the steel into sheets. Recycled steel cans can be made into new cars, steel girders for buildings, or new food cans.

Like aluminum, steel can also be recycled again and again. It is a never-ending process that saves energy and resources.

Recycling Steel Saves Energy too...

The average family uses 100 pounds of steel cans a year. Recycling that steel would save:

- **62 kWh of electricity**
- **50 lbs of coal**
- **125 lbs of iron**
- **2 lbs of limestone**

The Museum of Solid Waste and Energy

Station 6 — Recycling Paper & Glass

Recycling Paper

What is the number one material in the solid waste stream? Before you say plastics, look around your school classroom. What do you see? Posters? Notebooks? Magazines? Cardboard boxes? Textbooks? Bulletin boards decorated with construction paper? You get the picture. Paper is everywhere!

Paper is the number one material in the solid waste stream. For every 100 pounds of trash you generate, 40 pounds is paper.

Paper has many forms. It can be glossy or ragged; thin or thick. It can be the stuff of newspapers or the stuffing for diapers. In any case, most paper products are made from trees that have been cut and pulped, but paper can also be made from old cloth or grass.

How Paper Is Made

Papermaking uses a natural, renewable resource—trees! The first step in papermaking is harvesting the trees. Paper companies plant trees specifically for papermaking, much like an apple farmer grows apple trees to produce apples. If one tree is cut down, another is planted to replace it.

After the trees are harvested, they are delivered to a paper mill. Paper mills use every part of the tree so nothing is wasted. The bark and roots are burned and used for energy to run the paper mill.

The rest of the tree is chopped into small chips for pulping. Pulping is a chemical process that separates the wood fibers from lignen and other wood parts.

Pulp is the soft, spongy part of a tree. Lignin is the glue that holds a tree together. (If lignin is left in a paper product, the paper turns yellow and brittle when it's exposed to light. You have probably noticed that newspapers turn yellow very quickly. Lignin is usually left in newsprint since newspapers are only meant to last a day or so.)

After pulping, paper is the color of grocery bags. High quality papers are whitened with chlorine bleaches and sometimes coated with clays and adhesives to give papers a glossy finish.

Paper mills need a lot of energy to produce paper. Yet 50 percent of their energy comes from wood scraps that cannot be used to make paper. The rest of the energy is purchased from local electric power companies or generated on site by the mill using other energy sources.

Recycled Paper

Since paper is the number one material in the solid waste stream, using recycled paper can make a big dent in our solid waste problem.

Recycled paper is made from discarded waste paper and usually an infusion of fresh wood pulp. If the paper contains ink, the paper must be "deinked." Deinking also removes fillers, clays, and fiber fragments.

Almost all types of paper can be

From Rags to Paper Riches

(The following historical information about papermaking is provded by S.D. Warren Research, a division of Warren Paper, in its brochure, "Papermaking and Our Small Planet.")

At one time if someone wanted to leave a message for the world, he had to use a cave wall, a stone tablet, or an animal bone. Now people have their choice of a wide variety of paper products.

When paper was first invented in China, in 105 A.D., it was made mostly from rags, linen, or bamboo.

In 1719, a Dutch naturalist noticed that wasps' nests were made of a material that resembled paper. He observed that the wasps chewed wood filament and mixed them with their own saliva. This gave him the idea that paper could be made from wood fiber and led to the growth of the papermaking industry.

recycled today, but somes types are harder to recycle than others. Papers that are waxed, pasted, or gummed—or papers that are coated with plastic or aluminum foil—are usually not recycled because the process is more expensive.

Even papers that are normally recycled are not usually recycled together. Waste papers should be sorted. You shouldn't mix newspapers and cardboard boxes together for recycling.

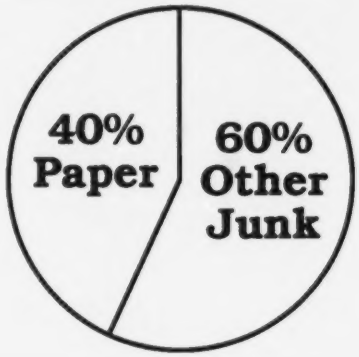
Different grades of paper are recycled into different types of new products. Old newspapers are usually made into new newsprint, egg cartons, or paperboard. Old corrugated boxes are made into new corrugated boxes or paperboard.

High-grade white office paper can be made into almost any new paper product—stationery, newsprint, facial tissue, paper towels, or paper for magazines and books.

Sometimes recyclers ask you to remove the glossy inserts that come with newspapers. Now you can probably guess why. The newsprint and glossy inserts are different types of paper!

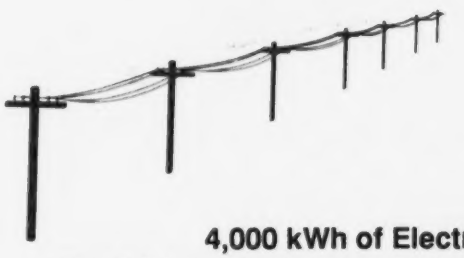
Glossy inserts have a heavy clay coating which some paper mills cannot accept. Besides, a paper mill gets more recyclable fibers from a ton of pure newsprint than it does from a ton of mixed newsprint that is weighed down with heavy clay-coated papers.

For every 100 pounds of waste you generate, 40 pounds is paper.



A ton of paper made from all recycled fibers, instead of virgin fibers, saves:

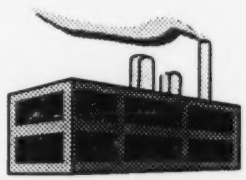
As Many as 17 Trees



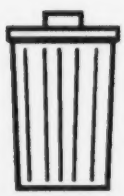
4,000 kWh of Electricity

(Enough to power the average home for six months.)

7,000 Gallons of Water



60 lbs.of Air Pollutants



3 Cubic Yards of Landfill Space

Paper Cannot Be Recycled Forever

Paper recycling is a little different than aluminum, steel, or glass recycling. Unlike most other recyclables, paper cannot be recycled over and over again. Eventually the fibers become too weak and short to be used again. That is why virgin paper fiber is often mixed with recycled paper when new paper products are made. Most cardboard boxes are a mixture of 50 percent new and 50 percent recycled fibers.

Recycling Paper Saves Energy and More

So does paper recycling save energy? Yes it does, although the energy savings are not as spectacular as they are with aluminum and steel recycling.

A paper mill uses 20 percent less energy to make paper from recycled paper than it does to make paper from fresh lumber.

There are other advantages too. Making recycled paper requires less chemicals and bleaches than making all-new paper, so recycled paper is less polluting and safer for the environment. Paper recycling also uses less water and saves valuable landfill space.

What about trees, you ask. Well, yes, recycled paper does save trees although paper is almost always made from trees specifically grown for papermaking. A tree harvested for papermaking is soon replaced by another so the cycle may continue.

Is Recycling Paper Always the Best Choice?

In the past few years, there has been a glut of old newspapers on the East Coast. People in some communities diligently collected newspapers for recycling, only to have stacks of them grow and grow until they had to pay someone to haul them away—sometimes to a landfill!

In these cases, it may have been better to burn the paper in a waste-to-energy plant. The heat energy from burning paper can be used to make steam and electricity.

Many experts say that the East Coast newspaper glut is only temporary and will turn around soon. The recent environmental movement has made people more aware of the paper they're using, and people are asking for and buying more recycled paper.

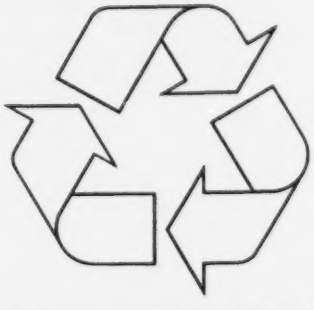
Besides, recycled paper looks better than it used to. Recycled paper doesn't have to be brown and "linty" looking; it can be as white and glossy as all-new paper.

Most newsprint producers say they will be using at least some recycled newsprint by 1995. By then, they are worried that there may not be enough old newspapers!

And while there may be a temporary glut of newsprint on the East Coast, paper producers everywhere want to buy other types of recyclable paper, particularly high-grade white office paper.

Do You Know the Recycling Symbols?

Many products packaged in recycled paperboard display this symbol to indicate that the carton is made from recycled paper.



Many paper products that are recyclable display this symbol.

Recycling Glass

Glass is used to package a host of food products: juices, jellies, vegetable oils, baby food, and so on. Glass makes up about seven percent of the municipal solid waste stream by weight.

What's the best way to deal with glass trash? Recycling? Burning? Landfilling?

After source reduction (using less glass to make a glass jar, for example), the best way to deal with glass trash is recycling.

Unlike paper, burning glass in waste-to-energy plants is not a good alternative to recycling. Glass does not provide any heat energy for making steam or electricity. Paper burns in a waste-to-energy plant; glass just melts.

Landfilling glass recovers none of its value either. So, recycling is usually the best choice.

Recycling glass is a pretty good energy saver. Using recycled glass to make new glass products requires 30 percent less energy than making it from all new materials. It saves energy because crushed glass, called cullet, melts at a lower temperature than the raw materials used to make glass. (New glass is made from sand, soda ash, and limestone.)

Using recycled glass to make new glass products uses 30% less energy than making it from all new materials.

Source: Glass Packaging Institute.

Recycling glass also reduces noxious air emissions and saves landfill space.

Old glass is easily made into new glass jars and bottles or into other glass products like fiberglass insulation.

And unlike paper, glass jars and bottles can be recycled over and over again. The glass doesn't wear out.

How to Recycle Glass

Preparing your used glass containers for recycling is easy. All you need to do is remove their lids or caps and rinse the containers in water. You don't need to scrub off the labels since they will burn up when the glass is melted down for recycling.

Most recyclers will ask you to sort glass containers by color—clear, green, or amber (golden brown). Once glass has been colored, the color cannot be removed. That means a maker of clear glass jars cannot use colored cullet.

So why do some manufacturers package their foods and beverages in green or amber colored glass containers? The colored glass protects some sensitive foods and beverages from light.

You cannot recycle all glass products. Light bulbs, ceramics, glass mirrors, window panes, and dishes are not made with the same materials as glass jars and bottles, so they should not be mixed in with glass recyclables.

Still, it's the bottles and jars that we throw away every day, not light bulbs and dishes.

The Museum of Solid Waste and Energy

Station 7 — Waste-to-Energy

Just Burn It!

Americans are producing more and more waste with each passing year. In 1960 the average American threw away 2.7 pounds of trash a day. Today the average American throws away four pounds of trash every day! What are we going to do with all that trash?

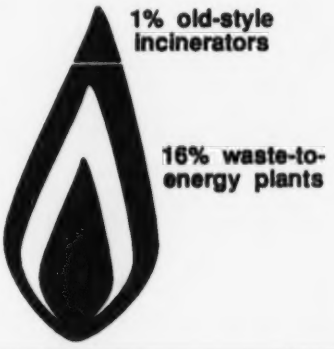
One solution is to burn it. (Burning is sometimes called "combustion.") All organic waste contains energy. Organic waste is waste that is made from plant or animal products.

People have burned one type of organic waste for millions of years. Can you guess what that organic waste is? It's wood.

Ancient peoples burned wood for its heat energy. They used the heat energy to keep them warm and to cook their food.

Today we can burn garbage and use its heat energy to make steam to heat buildings or to generate electricity. This may sound amazing, but it is really nothing new. Most electric power companies already burn another type of material to make electricity. That material is coal. Coal is a mineral that was formed from the remains of tiny plants and animals that died millions of years ago. Power companies use the heat energy in coal to make electricity.

The United States Burns 17% of its Garbage

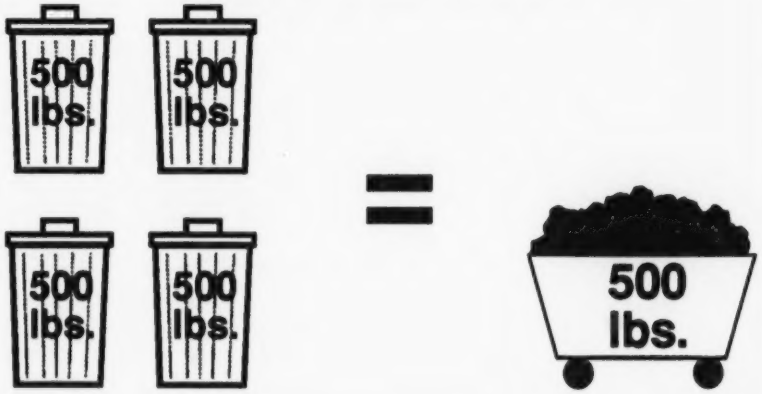


Source: Integrated Waste Services Association.

Garbage does not contain as much heat energy as coal though. It takes one ton (2,000 pounds) of garbage to equal the heat energy in just 500 pounds of coal.

Today there are 142 waste-to-energy plants in the United States. Plus there are another 34 old-style solid waste incinerators. These old-style incinerators simply burn trash to get rid of it. They do not use the heat energy to make steam or electricity. In total, the United States burned 17 percent of its garbage in 1990; 16 percent in waste-to-energy plants and one percent in old-style incinerators.

It takes 2,000 pounds of garbage to equal the heat energy in 500 pounds of coal



Why Burn Garbage?

Waste-to-energy plants generate enough electricity to supply 1.2 million households. But providing electricity is not the major advantage of waste-to-energy plants. Frankly, it costs more to generate electricity at a waste-to-energy plant than it does at a coal, nuclear, or hydro electricity plant. Instead, the major advantage of burning garbage is that it reduces the amount of garbage we bury in our landfills.

Burning waste substantially reduces the amount of trash going to a landfill. Let's look at an example.

The average American produces 1,500 pounds of waste a year. If this waste were landfilled, it would take more than two cubic yards of landfill space. That's the same space as a box three feet long, three feet wide, and six feet high—about the size of a refrigerator box. If that waste were burned, on the other hand, the ash residue would fit into a box three feet long, three feet wide, but only *nine inches* high!

Why is reducing the amount of waste buried in landfills so important? This country is in what some people have called a landfill crisis. Our existing landfills are filling up quickly and, in many places, local governments are not building new ones. The cost of building a landfill today runs about $2 to $4 million.

Taking the country as a whole, the United States has plenty of open space, of course, but it is expensive to transport garbage a few hundred miles just to put it in a landfill.

Inside a Waste-to-Energy Plant

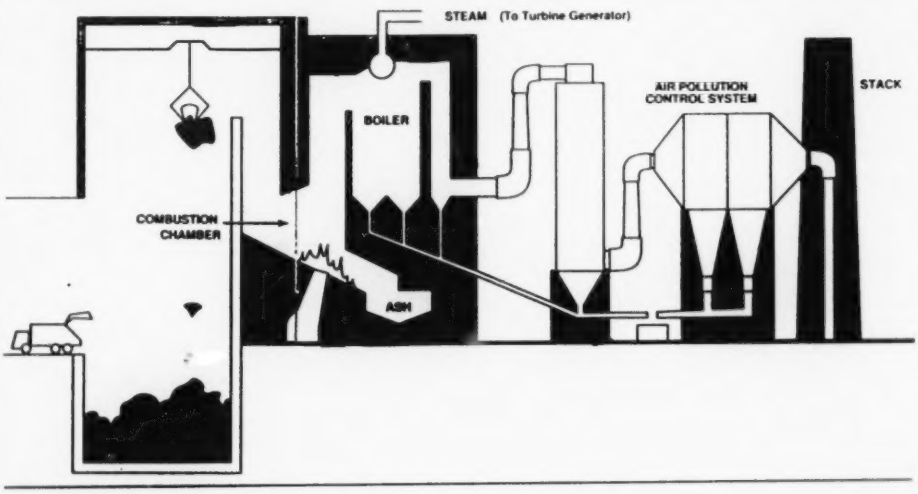
Waste-to-energy plants work very much like coal-fired power plants. The difference is the fuel. Waste-to-energy plants use garbage—not coal—to fire an industrial boiler.

But the same steps are used to make electricity at a waste-to-energy plant as a coal-fired power plant.

1. The fuel is burned, releasing heat energy.
2. The heat energy superheats water into steam.
3. The very high pressure of the steam turns the blades of a turbine generator to produce electricity.
4. The local utility company sends the electricity along power lines to homes, schools, and businesses.

You can think of garbage as a mixture of energy-rich "fuels." In every 100 pounds of garbage, more than 80 pounds can be burned as fuel to generate electricity at a power plant. The "fuels" include paper, plastics, and yard waste. A ton of garbage generates about 525 kilowatt-hours (kWh) of electricity, enough energy to heat a typical office building for one day.

The high-temperature incinerator in a waste-to-energy plant burns most of the waste. All that is left is a substance called ash.



A Waste-to-Energy Plant. *Trash goes in, energy goes out. Illustration courtesy of Wheelbrator, Inc.*

Ash is the solid residue left over when something is burned. It's like the ash left over from a wood fire in the bottom of a fireplace.

In a waste-to-energy plant, 2,000 pounds (one ton) of garbage is reduced to 300 to 600 pounds of ash.

Burning Garbage and the Environment

Some people are concerned that burning garbage may harm the environment. Like coal plants, waste-to-energy plants produce air pollution when the "fuel" is burned to produce steam or electricity.

Burning garbage releases the chemicals and substances found in the waste. Some chemicals can be dangerous to people, the environment, or both if they are not properly controlled.

Air Emissions

The Environmental Protection Agency (EPA)—an agency of the federal government—applies strict environmental rules to waste-to-energy plants. The EPA wants to make

sure that harmful chemical gases and particles are not just going out the smokestack.

The EPA requires waste-to-energy plants to use several anti-pollution devices, inlcuding scrubbers, fabric filters, and electrostatic precipitators.

Scrubbers clean chemical gas emissions by spraying a special liquid into the gas stream to neutralize acids.

Fabric filters and electrostatic precipitators remove particles from the emissions. The particles are then mixed with the ash that is removed from the bottom of the plant's furnace when it is cleaned.

Waste-to-energy plants also have a kind of built-in anti-pollution device. A waste-to-energy furnace burns at such high temperatures (1,800 to 2,000 degrees Fahrenheit) that many complex chemicals naturally break down into simpler, less harmful compounds.

Ash Disposal

Another challenge is the disposal of the ash after combustion. Ash can contain high concentrations of various metals that were present in the original waste. Textile dyes, printing inks, ceramics, and some electronic equipment, for example, contain the heavy metals lead and cadmium.

Separating waste before combustion can solve part of the problem. For instance, because batteries are the largest source of lead and cadmium in the solid waste stream, they should be taken out of the mix and not burned.

The ash must be disposed of carefully. Like regular garbage, it is not a good idea to place ash in an unprotected landfill because water trickling through the landfill, called "leachate," will pick up the chemicals and metals in the ash and could contaminate the ground and surface waters nearby.

At some landfills, ash is put in a special cell that is separate from the regular mixed waste. Other landfills, called "monofills," are built solely to hold ash.

Do Other Countries Use Waste-to-Energy?

Yes! Most countries do not have as many landfills as the United States. So many countries burn even more of their trash in waste-to-energy plants than we do.

Country	Percent of Waste Burned
Canada	4%
Great Britain	10%
United States	14%
The Netherlands	40%
Denmark	60%
Japan	72%
Switzerland	75%

Source: National Solid Waste Management Association, 1989.

To Burn or Not to Burn?

Some critics of waste-to-energy are afraid that burning waste will hamper recycling programs.

If everyone sends trash to the waste-to-energy plant, they say, there will be little incentive to recycle.

Several states have considered or are considering banning waste-to-energy plants unless recycling programs are in place. Massachusetts, New Jersey, and New York City have delayed new waste-to-energy plants, hoping to increase recycling first.

So, what's the story? Can recycling and burning waste co-exist?

At first glance, recycling and waste-to-energy seem to be at odds, but they really complement each other. That's because while it makes sense to recycle some materials, it makes better sense to burn others.

Let's look at aluminum, for example. Aluminum ore is so expensive to mine that recycling aluminum more than pays for itself. Also, because aluminum melts at a low temperature, it can clog up the works in a waste-to-energy plant. So clearly, aluminum is valuable to recycle and not useful to burn.

Paper, on the other hand, can either be burned or recycled—it all depends on the price the used paper will bring.

Today the East Coast has a glut of old newspapers. Some East Coast communities get paid next to nothing for the paper they have collected. And some communities cannot find anyone who wants to buy their old newspapers, so they end up paying a trucking company to haul the newspapers to a landfill!

In these cases, burning newspaper for its energy value is a good alternative. Other types of paper, such as those using colored inks and glossy finishes, are not so easily recycled and usually should be burned for their energy content.

Plastics are another matter. Because plastics are made from petroleum and natural gas, they provide an excellent source of energy for a waste-to-energy plant.

This is especially true since it is not as easy to recycle plastics (they almost always have to be hand-sorted) as it is steel, aluminum, or paper, and since making a product from recycled plastics may cost more than making it from new materials.

To burn or not to burn is not really the question. Ideally, we should use both recycling and waste-to-energy to manage our solid waste problem.

The Museum of Solid Waste and Energy

Station 8 — Landfilling

Yesterday and Today

For hundreds of years, people have used garbage dumps to get rid of their trash. Yesterday's garbage dump was nothing more than a pit, ravine, or field just outside town where people left their garbage.

People tossed all sorts of wastes into these dumps. The dumps were breeding grounds for disease-carrying pests such as flies, mosquitoes, and rats. Rainwater flushed filthy, and sometimes poisonous, liquids from the dump into nearby streams and groundwater supplies that people used for drinking, bathing, and clothes washing.

Later, some towns spread dirt to contain the most recently dumped waste and to discourage vermin. This helped, but it was little more than a cover-up for unsanitary dumping.

Today we still bury our garbage, although not in the open dumps of yesterday. About 66 percent of our garbage is hauled off in garbage trucks and packed into sanitary landfills—making landfilling America's number one way of getting rid of its trash. (The other 24 percent is either recycled or burned.)

The problem is America's landfills are filling up and communities don't want to build new ones or cannot afford to. Understandably, people don't want new landfills built in their backyards. And besides, a new landfill costs between $2 and $4 million to build.

What Do We Do with Our Trash?

Source: Environmental Protection Agency.

That's why there is a push to find new ways to deal with solid waste—recycling and burning, for instance. But there will always be a need for some landfills. Why? Because not all solid waste can be recycled or burned. How do you recycle a broken light bulb, and why burn it for that matter if it doesn't provide any heat energy?

Landfill burial is the only feasible way to dispose of some types of waste, and sometimes it's the safest way too. Generally, the best disposal method for hazardous wastes—batteries, paints, pesticides, and the like—are state-of-the-art landfills.

Used oil from your family car, on the other hand, should be taken to a collection station so it can be recycled into new fuel, or burned to produce usable energy.

Trash Flash Back

"Thither were brought the dead dogs and cats, the kitchen garbage and the like, and duly dumped. This festering, rotten mess was picked over by ragpickers and wallowed over by pigs—pigs and humans contesting for a living in it, and as the heaps increased, the odors increased also, and the mass lay corrupting under a tropical sun, dispersing the pestilential fumes where the winds carried them," *The Rev. Hugh Miller Thompson, "Disposal of City Garbage at New Orleans,"* Sanitarian, *November 1879.*

The Modern Landfill

Now that open dumping is illegal, deciding where to put a landfill requires careful planning. Skilled engineers inspect potential landfill sites. They look at a number of things including:

- the geology of the area;
- the nature of the local environment;
- how easy the site is to reach;
- how far away the site is from the people and businesses that generate the waste.

Work on a landfill site begins only after the site passes strict legal, environmental, and engineering tests. It is not a quick procedure; landfills can take five or more years to complete, and cost a community $2 to $4 million.

Environmentally Safe Designs

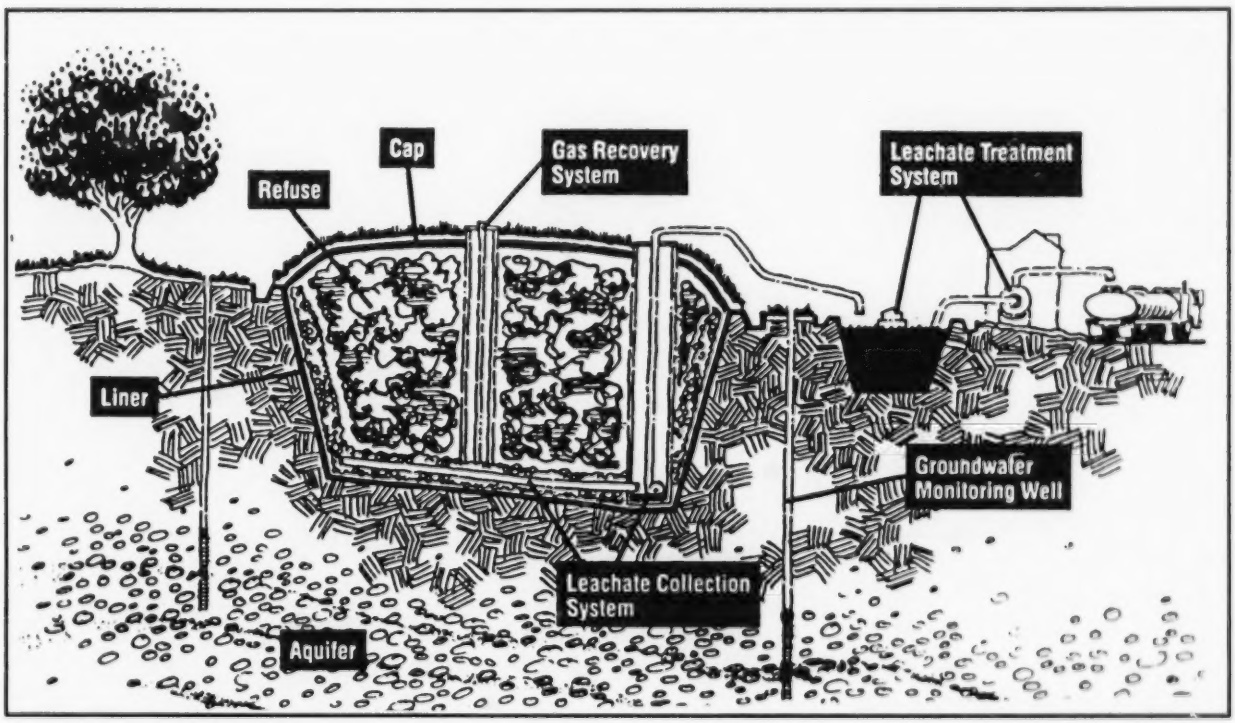
Today's landfill is very different from the open dump of yesteryear. For one thing, new landfills are situated where clay deposits and other land features act as natural buffers between the landfill and the environment.

Second, the bottom and sides of a landfill are lined with layers of compacted clay or plastic to keep the liquids from decaying waste, called **leachate**, from escaping into the soil.

A network of drains collects the leachate and pumps it to the surface where it can be treated. Ground wells are also drilled into and around the landfill to monitor ground-water quality and to detect any contamination. These safety measures keep groundwater, which is the main source of drinking water in many communities, clean and pure.

To protect the environment even more, the landfill is divided into a series of individual cells. As waste is deposited in the landfill each day, only a small portion of the site (known as the "working face") is used, minimizing exposure to wind and rain.

At the end of each day's activities, workers spread a layer of earth (called the "daily cover") across the compacted waste to minimize odor and to control vermin. The workers fill and cap off each cell with a layer of clay and earth, and then seed the area with native grasses.



A Modern Landfill: *Today's landfills are not yesterday's dumps. Illustration courtesy of National Solid Waste Management Association.*

What Happens When a Landfill Is Full?

When a landfill is full, workers seal and cover the landfill with a final cap of clay and dirt. Workers continue to monitor the ground wells for years after a landfill is closed to keep tabs on the quality of groundwater on and around the site.

Old landfill sites can be landscaped to blend in with their surroundings, or specially developed to provide an asset to a community. Closed landfills can be turned into anything from parks to parking lots, from golf courses to ski slopes.

Building homes and businesses on these sites is generally not permitted, though, since it can take many years for the ground to settle.

Landfills Are Like Tupperware

You have probably seen all sorts of consumer products, from paper bags to egg cartons, claim they are "biodegradable." But what does that mean? And are the claims true?

Biodegradation is a natural process. It happens when microorganisms, such as fungi or bacteria, secrete enzymes that chemically break down (or "degrade") dead plants and animals. In other words, the wastes rot.

Most organic wastes—food scraps, paper, grass clippings, and so on—are biodegradable under normal environmental conditions. That means, given enough time, the waste will disintegrate into harmless substances, enriching the soil with waste nutrients.

A landfill is *not* a normal environmental condition, though, nor is it intended to be. Instead, a landfill is more like a tightly sealed storage container. A landfill is designed to *inhibit* degradation to protect the environment from harmful contamination. Deprived of air and water, even organic wastes, like paper and grass clippings, degrade very slowly in a landfill.

Landfill Energy

Did you know that landfills can be a source of energy—like coal or petroleum? Here's the story.

Organic waste produces a gas called **methane** as it decomposes, or rots. Methane is the same thing as natural gas, the fuel sold by natural gas utility companies.

Methane gas is colorless and odorless (natural gas utilities add an odorant so people can detect seeping gas), but it can be dangerous to people or the environment. New rules require landfills to collect methane gas as a pollution and safety measure.

Some landfills simply burn the methane gas in a controlled fashion to get rid of it. But the methane can be used as an energy source.

Landfills can collect the methane gas, treat it, and then sell it as a commercial fuel; or they can burn it to generate steam and electricity.

The city of Florence, Alabama recovers 32 million cubic feet of methane gas each day from its municipal landfill, which is enough gas to heat 24,000 homes. The city simply processes the gas and then pumps it into the city's natural gas pipelines.

Trash from the Past

Archaeologists are trained to dig up trash from the past, so when William L. Rathje, a professor of Anthropology at the University of Arizona, learned that no one had ever dug into an American landfill, he formed the Garbage Project to discover just what was inside one.

After digging into three landfills in Arizona, California, and Illinois, Rathje found out that there are a lot of garbage myths.

For one thing, he and his team discovered that it takes a lot longer for paper and other organic wastes to decompose than people previously thought.

Rathje and his team found newspapers from the late 1970s that were still readable. He found "organic debris—green grass clippings, a T-bone steak with lean and fat, and

five hot dogs—[that] looked even better!"

Rathje's research suggests that biodegradation—since it happens so slowly in a landfill—may not be the answer to America's landfill crunch. So, switching to biodegradable products (using paper bags instead of plastic bags, for instance) probably won't do much to solve America's solid waste problem.

Rathje also discovered that disposable diapers and fast-food packaging take up less landfill space than people generally believe.

People in a poll estimated that disposable diapers occupy somewhere between five and 40 percent of landfill space. But Rathje's study showed that diapers were less than one percent by weight or 1.5 percent by volume of the waste in landfills, far less than people assumed.

What's filling our landfills then? According to Rathje it's paper, especially newspapers. Rathje concluded that recycling newspapers could significantly lengthen the life of a landfill.

Rathje and his team of archaeologists plan to conduct more digs to find out why paper and other organic waste degrade slowly in landfills.

"It's not a pleasant task," Rathje says, "but someone has to do it."

Station Guides

Station Guide—The Museum of Solid Waste and Energy

Station 1 — Introduction to Solid Waste

How to Make Your Museum Station

Congratulations! The Director of the Museum of Solid Waste and Energy has just hired your group to be museum curators. (A curator is someone who is in charge of caring for an exhibit at a museum or zoo.) Your group will create Station One. Other museum curators will be creating stations on different solid waste and energy topics. Together you will create an eight-station tour for the Museum of Solid Waste and Energy. Your class, school, or even your entire community will be invited to tour your station.

So, roll up your sleeves. Here is a quick look at what you will need to do:

- Read the museum backgrounder for your station.
- Find the main ideas and write a three-minute script for your station tour.
- Make posters and hands-on displays for your tour.

Step 1—Learn by Example

Please take out your museum backgrounder. Your job is to tell the story of your backgrounder to others and to create posters or displays that highlight the most important facts or ideas. Your boss, the museum director, has done a sample for you since you are new on the job. You will follow his example as you create your station tour.

Let's see how the director created a tour script and exhibit for the opening of your station. Of course the first thing he did was read the entire backgrounder. Then he underlined the most important ideas or facts—things he thought others should know or things he thought were particularly interesting. You can see what the director wrote down in the box at the bottom of this page. The next thing the director did was brainstorm a few ideas for the exhibits. You can see his ideas for exhibits in the box too.

Director's Sample

1. **Main Ideas**—The director underlined the main ideas for the first section of your backgrounder. You will underline the main ideas on your backgrounder too.

   1) The average American generates 4 pounds of garbage each day. 2) Landfills compress garbage. 3) Weight of garbage vs. volume of garbage. 4) Landfills are filling up in USA.

2. **Exhibits**—Next, the director jotted down some ideas for presenting the information to visitors touring your museum station. You will decide what types of exhibits your group will use for your station.

   Make two boxes (Box A is 12" x 12" x 8" ; Box B is 12" x 12" x 3/4") showing the weight and volume of waste generated daily by the average American.

   Write '4 Pounds Each Day' on the boxes then decorate the boxes with construction paper.

   Ask the people who come to see our museum station to pass the box around so they feel the weight.

3. **Tour Script**

   Hello! Welcome to the Museum of Solid Waste and Energy. You'll be learning a lot of garbage at this museum!

   But seriously, please pass this box around. Does it feel heavy? It weighs four pounds. That's how much waste the average American generates in one day. The volume of that waste would fit into a box this size. (Box A)

   Now when the garbage is compressed in a landfill, it would fit into a box this size. (Box B) Landfilled garbage takes up only about a tenth of the space as non-compressed garbage. Why is the volume of garbage important? Because landfill space is shrinking in this country. And, afterall, landfills don't close because they're overweight, they close because they have reached their volume capacity.

After getting these ideas together, the director wrote a script to go along with the first part of your backgrounder. He wrote the script as if he was giving a tour to a group of people. You'll want to keep that in mind when you write your script too. You may read the director's tour script in the box at the bottom of page one.

Step 2—Learn by Doing

Now it's your turn. Your group can work together. Here's what you need to do:

1. **Read your backgrounder.**
   Read silently, or have one person read aloud as the others follow along.

2. **Underline the main ideas in each section.**
   The backgrounder is divided into sections with headings or boxes. Working section by section, each person should underline the main ideas on his or her backgrounder.

3. **Using your own sheet of paper, write down at least two ideas for exhibits for each section.**
   Again working section by section, decide what displays would make your station interesting. Remember, the exhibits will need to tie into your tour script.

4. **Write a tour script for your station.**
   Work together as a group to write the script for your station tour. (Choose one person to write down your group's script.)

   You may take sentences straight from the backgrounder if you want. Just keep in mind that you will be speaking to a group of people, so make your discussion conversational. You may want to ask your visitors questions, for example, or pass a display around for them to look at. You also will need to keep your script very short. You may need to combine sections of your backgrounder or eliminate a section if your script is running long. Remember, your tour should only take about three minutes!

   NOTE: Your teacher will be checking your progress periodically to make sure you're on the right track. Try to stay on schedule. Don't get so bogged down with details that you fall behind.

Step 3—Decide Who Does What

Next decide who will do what in your group. Who will be the tour guide(s)? Who will make which displays?

On a sheet of paper write down each person's name. Next to their name, jot down the person's tasks. This will ensure everything gets done on time.

Step 4—Creation!

Are your creative juices brewing? You have the next few days to create the displays to go along with your station and to refine your script.

More Help

Station One Main Ideas—You'll want to be sure to include the following information in your station tour:

What municipal solid waste is • How much trash average American generates each day • Waste products and waste materials • Weight vs. Volume (Landfills close because they're filled to capacity, not because they're overweight) • How much waste is landfilled, burned, and recycled, by percentage • Four steps to managing the solid waste problem.

Hints for Making a Great Station Tour

- Try to involve your visitors in your station tour. Ask them questions or pose problems.
- Don't use too many posters for your exhibits. Try to use props or 3-dimensional displays as much as possible. Example: use beverage cans to represent garbage cans, etc.
- Once you have made your station tour, time it to see how long it is. You may need to eliminate information or re-write sentences if your presentation is running long.
- The tour guide(s) should memorize the script for the museum tour. Nobody wants to listen to somebody reading from a piece of paper.
- The tour guide(s) should rehearse in front of your group. Together you may come up with ways to improve the script or displays.

Station Guide—The Museum of Solid Waste and Energy

Station 2 — Source Reduction

How to Make Your Museum Station

Congratulations! The Director of the Museum of Solid Waste and Energy has just hired your group to be museum curators. (A curator is someone who is in charge of caring for an exhibit at a museum or zoo.) Your group will create Station Two. Other museum curators will be creating stations on different solid waste and energy topics. Together you will create an eight-station tour for the Museum of Solid Waste and Energy. Your class, school, or even your entire community will be invited to tour your station.

So, roll up your sleeves. Here is a quick look at what you will need to do:

- Read the museum backgrounder for your station.
- Find the main ideas and write a three-minute script for your station tour.
- Make posters and hands-on displays for your tour.

Step 1—Learn by Example

Please take out your museum backgrounder. Your job is to tell the story of your backgrounder to others and to create posters or displays that highlight the most important facts or ideas. Your boss, the museum director, has done a sample for you since you are new on the job. You will follow his example as you create your station tour.

Let's see how the director created a tour script and exhibit for the opening of your station. Of course the first thing he did was read the entire backgrounder. Then he underlined the most important ideas or facts—things he thought others should know or things he thought were particularly interesting. You can see what the director wrote down in the box at the bottom of this page. The next thing the director did was brainstorm a few ideas for the exhibits. You can see his ideas for exhibits in the box too.

Director's Sample

1. **Main Ideas**—The director wrote down the main ideas for the first section of your backgrounder. You will underline the main ideas on your backgrounder too.

   1) *What source reduction means--reducing waste at the very beginning.*

   2) *Why packaging has become target of most source reduction efforts.*

   3) *Why packaging is important--sanitary storage, convenient, long shelf-life.*

2. **Exhibits**—Next, the director jotted down some ideas for presenting the information to visitors touring your museum station. You will decide what types of exhibits your group will use for your station.

   1) *Make a colorful poster that tells people what source reduction is and why it should be first step.*

   2) *Get different types of packages (soup in a can, bread in plastic wrapper, egg carton, etc.) to show why food needs some packaging.*

3. **Tour Script:**

   Hello! We are going to talk about reducing waste. Source reduction means trimming the amount of material that enters the waste stream. Common sense tells us that the easiest way to reduce waste is not to make it in the first place. Source reduction should be the first step in any waste management program. Reducing waste at the start means there will be less waste to be recycled, burned, or landfilled later.

   Packaging has become the target of most source reduction efforts. Why? Because it is the single largest waste product in this country. Just take a look at some of the items lining our grocery store shelves. Bread is wrapped in plastic. Soup comes in a can. Cookies are arranged on plastic trays that are then slipped inside paper bags. Six bottles of cola are wrapped together with plastic or cardboard.

After getting these ideas together, the director wrote a script to go along with the first part of your backgrounder. He wrote the script as if he was giving a tour to a group of people. You'll want to keep that in mind when you write your script too. You may read the director's tour script in the box at the bottom of page one.

Step 2—Learn by Doing

Now it's your turn. Your group can work together. Here's what you need to do:

1. **Read your backgrounder.**
   Read silently, or have one person read aloud as the others follow along.

2. **Underline the main ideas in each section.**
   The backgrounder is divided into sections with headings or boxes. Working section by section, each person should underline the main ideas on his or her backgrounder.

3. **Using your own sheet of paper, write down at least two ideas for exhibits for each section.**
   Again working section by section, decide what displays would make your station interesting. Remember, the exhibits will need to tie into your tour script.

4. **Write a tour script for your station.**
   Work together as a group to write the script for your station tour. (Choose one person to write down your group's script.)

   You may take sentences straight from the backgrounder if you want. Just keep in mind that you will be speaking to a group of people, so make your discussion conversational. You may want to ask your visitors questions, for example, or pass a display around for them to look at. You also will need to keep your script very short. You may need to combine sections of your backgrounder or eliminate a section if your script is running long. Remember, your tour should only take about three minutes!

   NOTE: Your teacher will be checking your progress periodically to make sure you're on the right track. Try to stay on schedule. Don't get so bogged down with details that you fall behind.

Step 3—Decide Who Does What

Next decide who will do what in your group. Who will be the tour guide(s)? Who will make which displays?

On a sheet of paper write down each person's name. Next to their name, jot down the person's tasks. This will ensure everything gets done on time.

Step 4—Creation!

Are your creative juices brewing? You have the next few days to create the displays to go along with your station and to refine your script.

More Help

Station Two Main Ideas—You'll want to be sure to include the following information in your station tour:

What source reduction is • Why source reduction should be the first step in any waste management program • Why packaging is the target of most source reduction efforts • Packaging serves many useful purposes, so we can't eliminate it all together • How companies are making lighter, thinner packages, or concentrated products • Surprise! Drink boxes use less packaging than other single-serve containers • What you can do to reduce waste at home.

Hints for Making a Great Station Tour

- Try to involve your visitors in your station tour. Ask them questions or pose problems.
- Don't use too many posters for your exhibits. Try to use props or 3-dimensional displays as much as possible. Example: use beverage cans to represent garbage cans, etc.
- Once you have made your station tour, time it to see how long it is. You may need to eliminate information or re-write sentences if your presentation is running long.
- The tour guide(s) should memorize the script for the museum tour. Nobody wants to listen to somebody reading from a piece of paper.
- The tour guide(s) should rehearse in front of your group. Together you may come up with ways to improve the script or displays.

Station Guide—The Museum of Solid Waste and Energy

Station 3 — Introduction to Recycling

How to Make Your Museum Station

Congratulations! The Director of the Museum of Solid Waste and Energy has just hired your group to be museum curators. (A curator is someone who is in charge of caring for an exhibit at a museum or zoo.) Your group will create Station Three. Other museum curators will be creating stations on different solid waste and energy topics. Together you will create an eight-station tour for the Museum of Solid Waste and Energy. Your class, school, or even your entire community will be invited to tour your station.

So, roll up your sleeves. Here is a quick look at what you will need to do:

- Read the museum backgrounder for your station.
- Find the main ideas and write a three-minute script for your station tour.
- Make posters and hands-on displays for your tour.

Step 1—Learn by Example

Please take out your museum backgrounder. Your job is to tell the story of your backgrounder to others and to create posters or displays that highlight the most important facts or ideas. Your boss, the museum director, has done a sample for you since you are new on the job. You will follow his example as you create your station tour.

Let's see how the director created a tour script and exhibit for the opening of your station. Of course the first thing he did was read the entire backgrounder. Then he underlined the most important ideas or facts—things he thought others should know or things he thought were particularly interesting. You can see what the director wrote down in the box at the bottom of this page. The next thing the director did was brainstorm a few ideas for the exhibits. You can see his ideas for exhibits in the box too.

Director's Sample

1. **Main Ideas**—The director wrote down the main ideas for the first section of your backgrounder. You will underline the main ideas on your backgrounder too.

   1) What recycling is. 2) What closed-loop recycling is.

   3) The advantages of recycling.

2. **Exhibits**—Next, the director jotted down some ideas for presenting the information to visitors touring your museum station. You will decide what types of exhibits your group will use for your station.

   1) Use two aluminum cans to show what closed-loop recycling is, and a plastic bottle and a plastic flower pot to show what closed-loop recycling is not.

   2) Make a colorful poster that shows the advantages of recycling.

3. **Tour Script:**

   Hello and welcome to Station Three. We are going to explore recycling.

   Recycling means to use something again—to turn something old into something new. We can recycle newspapers to make egg cartons. We can recycle steel cans to make automobile bodies.

   We close the recycling loop when an old product is made into the same thing again. Closed-loop recycling is turning an old aluminum can into a new aluminum can, or an old glass jar into a new glass jar. Turning plastic Coke bottles into plastic flower pots is not closed-loop recycling because a completely different product is made.

   There are several reasons why recycling makes sense, as the Why Recycle poster points out. . .

After getting these ideas together, the director wrote a script to go along with the first part of your backgrounder. He wrote the script as if he was giving a tour to a group of people. You'll want to keep that in mind when you write your script too. You may read the director's tour script in the box at the bottom of page one.

Step 2—Learn by Doing

Now it's your turn. Your group can work together. Here's what you need to do:

1. **Read your backgrounder.**
   Read silently, or have one person read aloud as the others follow along.

2. **Underline the main ideas in each section.**
   The backgrounder is divided into sections with headings or boxes. Working section by section, each person should underline the main ideas on his or her backgrounder.

3. **Using your own sheet of paper, write down at least two ideas for exhibits for each section.**
   Again working section by section, decide what displays would make your station interesting. Remember, the exhibits will need to tie into your tour script.

4. **Write a tour script for your station.**
   Work together as a group to write the script for your station tour. (Choose one person to write down your group's script.)

   You may take sentences straight from the backgrounder if you want. Just keep in mind that you will be speaking to a group of people, so make your discussion conversational. You may want to ask your visitors questions, for example, or pass a display around for them to look at. You also will need to keep your script very short. You may need to combine sections of your backgrounder or eliminate a section if your script is running long. Remember, your tour should only take about three minutes!

   NOTE: Your teacher will be checking your progress periodically to make sure you're on the right track. Try to stay on schedule. Don't get so bogged down with details that you fall behind.

Step 3—Decide Who Does What

Next decide who will do what in your group. Who will be the tour guide(s)? Who will make which displays?

On a sheet of paper write down each person's name. Next to their name, jot down the person's tasks. This will ensure everything gets done on time.

Step 4—Creation!

Are your creative juices brewing? You have the next few days to create the displays to go along with your station and to refine your script.

More Help

Station Three Main Ideas—You'll want to be sure to include the following information in your station tour:

What recycling is • The advantages of recycling • Closed-loop recycling and why it's the ideal type of recycling • How much waste Americans recycle and how it's growing • Mandatory vs. voluntary recycling • Keys to successful program are ease and convenience • When recycling is not recycling—collection is only one step.

Hints for Making a Great Station Tour

- Try to involve your visitors in your station tour. Ask them questions or pose problems.
- Don't use too many posters for your exhibits. Try to use props or 3-dimensional displays as much as possible. Example: use beverage cans to represent garbage cans, etc.
- Once you have made your station tour, time it to see how long it is. You may need to eliminate information or re-write sentences if your presentation is running long.
- The tour guide(s) should memorize the script for the museum tour. Nobody wants to listen to somebody reading from a piece of paper.
- The tour guide(s) should rehearse in front of your group. Together you may come up with ways to improve the script or displays.

Station Guide—The Museum of Solid Waste and Energy

Station 4 — Plastics Recycling

How to Make Your Museum Station

Congratulations! The Director of the Museum of Solid Waste and Energy has just hired your group to be museum curators. (A curator is someone who is in charge of caring for an exhibit at a museum or zoo.) Your group will create Station Four. Other museum curators will be creating stations on different solid waste and energy topics. Together you will create an eight-station tour for the Museum of Solid Waste and Energy. Your class, school, or even your entire community will be invited to tour your station.

So, roll up your sleeves. Here is a quick look at what you will need to do:

- Read the museum backgrounder for your station.
- Find the main ideas and write a three-minute script for your station tour.
- Make posters and hands-on displays for your tour.

Step 1—Learn by Example

Please take out your museum backgrounder. Your job is to tell the story of your backgrounder to others and to create posters or displays that highlight the most important facts or ideas. Your boss, the museum director, has done a sample for you since you are new on the job. You will follow his example as you create your station tour.

Let's see how the director created a tour script and exhibit for the opening of your station. Of course the first thing he did was read the entire backgrounder. Then he underlined the most important ideas or facts—things he thought others should know or things he thought were particularly interesting. You can see what the director wrote down in the box at the bottom of this page. The next thing the director did was brainstorm a few ideas for the exhibits. You can see his ideas for exhibits in the box too.

Director's Sample

1. **Main Ideas**—The director wrote down the main ideas for the first section of your backgrounder. You will underline the main ideas on your backgrounder too.

   1) Plastics are made from natural gas and petroleum.

   2) Plastics are energy-efficient in manufacturing and shipping.

2. **Exhibits**—Next, the director jotted down some ideas for presenting the information to visitors touring your museum station. You will decide what types of exhibits your group will use for your station.

   1) Display a plastic and paper cup. 2) Display a glass ketchup bottle and a plastic ketchup bottle.

   Put labels on the ketchup bottles to show how much each one weighs.

3. **Tour Script:**

   Welcome to the plastics station! First of all, let's find out what plastics are. The basic raw material for plastics is petroleum or natural gas. These fossil fuels are combined with other elements, such as oxygen or chlorine, to make different types of plastic. There are hundreds of plastics formulations!

   Another thing plastics are is energy efficient. Do you see the paper and foam plastic cups on the table? Which one do you think takes **more** energy to make? Paper or plastic?

   Well, I hope you didn't say plastic! It takes more energy to make the **paper** cup than it does the foam cup. Likewise, it takes more energy to make that glass ketchup bottle you see sitting on the table than it does the plastic ketchup bottle.

   And did you notice how much the glass bottle weighs compared to the plastic bottle? That's another plus for plastics. Since plastics are lightweight, it takes less energy to transport a truckload of plastic containers than it does to transport their heavier glass cousins.

BEST COPY AVAILABLE

After getting these ideas together, the director wrote a script to go along with the first part of your backgrounder. He wrote the script as if he was giving a tour to a group of people. You'll want to keep that in mind when you write your script too. You may read the director's tour script in the box at the bottom of page one.

Step 2—Learn by Doing

Now it's your turn. Your group can work together. Here's what you need to do:

1. **Read your backgrounder.**
   Read silently, or have one person read aloud as the others follow along.

2. **Underline the main ideas in each section.**
   The backgrounder is divided into sections with headings or boxes. Working section by section, each person should underline the main ideas on his or her backgrounder.

3. **Using your own sheet of paper, write down at least two ideas for exhibits for each section.**
   Again working section by section, decide what displays would make your station interesting. Remember, the exhibits will need to tie into your tour script.

4. **Write a tour script for your station.**
   Work together as a group to write the script for your station tour. (Choose one person to write down your group's script.)

   You may take sentences straight from the backgrounder if you want. Just keep in mind that you will be speaking to a group of people, so make your discussion conversational. You may want to ask your visitors questions, for example, or pass a display around for them to look at. You also will need to keep your script very short. You may need to combine sections of your backgrounder or eliminate a section if your script is running long. Remember, your tour should only take about three minutes!

   NOTE: Your teacher will be checking your progress periodically to make sure you're on the right track. Try to stay on schedule. Don't get so bogged down with details that you fall behind.

Step 3—Decide Who Does What

Next decide who will do what in your group. Who will be the tour guide(s)? Who will make which displays?

On a sheet of paper write down each person's name. Next to their name, jot down the person's tasks. This will ensure everything gets done on time.

Step 4—Creation!

Are your creative juices brewing? You have the next few days to create the displays to go along with your station and to refine your script.

More Help

Station Four Main Ideas—You'll want to be sure to include the following information in your station tour:

What plastics are made from • Why plastics are enrgy efficient • Percentage of plastics in waste stream by weight and volume • How to recycle plastics • The seven codes for plastics packaging and containers • Plastics recycling steps • Burning plastics • Biodegradable and photodegradable plastics

Hints for Making a Great Station Tour

- Try to involve your visitors in your station tour. Ask them questions or pose problems.
- Don't use too many posters for your exhibits. Try to use props or 3-dimensional displays as much as possible. Example: use beverage cans to represent garbage cans, etc.
- Once you have made your station tour, time it to see how long it is. You may need to eliminate information or re-write sentences if your presentation is running long.
- The tour guide(s) should memorize the script for the museum tour. Nobody wants to listen to somebody reading from a piece of paper.
- The tour guide(s) should rehearse in front of your group. Together you may come up with ways to improve the script or displays.

Station Guide—The Museum of Solid Waste and Energy

Station 5 — Recycling Metals

How to Make Your Museum Station

Congratulations! The Director of the Museum of Solid Waste and Energy has just hired your group to be museum curators. (A curator is someone who is in charge of caring for an exhibit at a museum or zoo.) Your group will create Station Five. Other museum curators will be creating stations on different solid waste and energy topics. Together you will create an eight-station tour for the Museum of Solid Waste and Energy. Your class, school, or even your entire community will be invited to tour your station.

So, roll up your sleeves. Here is a quick look at what you will need to do:

- Read the museum backgrounder for your station.
- Find the main ideas and write a three-minute script for your station tour.
- Make posters and hands-on displays for your tour.

Step 1—Learn by Example

Please take out your museum backgrounder. Your job is to tell the story of your backgrounder to others and to create posters or displays that highlight the most important facts or ideas. Your boss, the museum director, has done a sample for you since you are new on the job. You will follow his example as you create your station tour.

Let's see how the director created a tour script and exhibit for the opening of your station. Of course the first thing he did was read the entire backgrounder. Then he underlined the most important ideas or facts—things he thought others should know or things he thought were particularly interesting. You can see what the director wrote down in the box at the bottom of this page. The next thing the director did was brainstorm a few ideas for the exhibits. You can see his ideas for exhibits in the box too.

Director's Sample

1. **Main Ideas**—The director wrote down the main ideas for the first section of your backgrounder. You will underline the main ideas on your backgrounder too.

   1) We don't throw away all types of metals, mostly aluminum and steel.

   2) Recycling aluminum saves a huge amount of energy.

2. **Exhibits**—Next, the director jotted down some ideas for presenting the information to visitors touring your museum station. You will decide what types of exhibits your group will use.

   1) To show how much energy aluminum recycling saves, get about 25 aluminum cans and a measuring cup. Fill the cup with fake gasoline (use Cherry 7-Up). Ask people how many cans would have to be recycled to equal the energy in one cup of gasoline.

3. **Tour Script:**

   Hello! Welcome to Station Five. We are going to talk about recycling two kinds of metals—aluminum and steel. Let's start with aluminum. How many of you recycle aluminum beverage cans? (*Pause.*)

   I hope you do because recycling aluminum saves a lot of energy. Making aluminum from recycled materials uses only five percent of the energy as making it from all-new materials

   Now I have a puzzle for you. We said recycling aluminum saves energy so let's see what that energy looks like. Will one person please come forward to the table? (*Pause.*)

   Do you see the cup of gasoline and the collection of aluminum cans? I want you to slide over the number of cans you think would have to be recycled in order to match the energy in that cup of gasoline. (*Pause.*)

   So, how many cans did you slide over? Looks like a lot! Well, I have to tell you that recycling just **two** aluminum cans saves the energy equivalent of one cup of gasoline.

After getting these ideas together, the director wrote a script to go along with the first part of your backgrounder. He wrote the script as if he was giving a tour to a group of people. You'll want to keep that in mind when you write your script too. You may read the director's tour script in the box at the bottom of page one.

Step 2—Learn by Doing

Now it's your turn. Your group can work together. Here's what you need to do:

1. **Read your backgrounder.**
   Read silently, or have one person read aloud as the others follow along.

2. **Underline the main ideas in each section.**
   The backgrounder is divided into sections with headings or boxes. Working section by section, each person should underline the main ideas on his or her backgrounder.

3. **Using your own sheet of paper, write down at least two ideas for exhibits for each section.**
   Again working section by section, decide what displays would make your station interesting. Remember, the exhibits will need to tie into your tour script.

4. **Write a tour script for your station.**
   Work together as a group to write the script for your station tour. (Choose one person to write down your group's script.)

   You may take sentences straight from the backgrounder if you want. Just keep in mind that you will be speaking to a group of people, so make your discussion conversational. You may want to ask your visitors questions, for example, or pass a display around for them to look at. You also will need to keep your script very short. You may need to combine sections of your backgrounder or eliminate a section if your script is running long. Remember, your tour should only take about three minutes!

   NOTE: Your teacher will be checking your progress periodically to make sure you're on the right track. Try to stay on schedule. Don't get so bogged down with details that you fall behind.

Step 3—Decide Who Does What

Next decide who will do what in your group. Who will be the tour guide(s)? Who will make which displays?

On a sheet of paper write down each person's name. Next to their name, jot down the person's tasks. This will ensure everything gets done on time.

Step 4—Creation!

Are your creative juices brewing? You have the next few days to create the displays to go along with your station and to refine your script.

More Help

Station Five Main Ideas—You'll want to be sure to include the following information in your station tour:

Why we don't throw away all metals • Recycling aluminum saves a huge amount of energy • Aluminum trash is valuable • Recycling aluminum cans into new cans is a good example of closed-loop recycling • Steel is America's most recycled material • Steel cans are often called tin cans because of their inner coating • Recycling steel is a big energy saver too • Steel trash is easily separated from other garbage because steel sticks to a magnet.

Hints for Making a Great Station Tour

- Try to involve your visitors in your station tour. Ask them questions or pose problems.
- Don't use too many posters for your exhibits. Try to use props or 3-dimensional displays as much as possible. Example: use beverage cans to represent garbage cans, etc.
- Once you have made your station tour, time it to see how long it is. You may need to eliminate information or re-write sentences if your presentation is running long.
- The tour guide(s) should memorize the script for the museum tour. Nobody wants to listen to somebody reading from a piece of paper.
- The tour guide(s) should rehearse in front of your group. Together you may come up with ways to improve the script or displays.

Station Guide—The Museum of Solid Waste and Energy

Station 6 — Recycling Paper & Glass

How to Make Your Museum Station

Congratulations! The Director of the Museum of Solid Waste and Energy has just hired your group to be museum curators. (A curator is someone who is in charge of caring for an exhibit at a museum or zoo.) Your group will create Station Six. Other museum curators will be creating stations on different solid waste and energy topics. Together you will create an eight-station tour for the Museum of Solid Waste and Energy. Your class, school, or even your entire community will be invited to tour your station.

So, roll up your sleeves. Here is a quick look at what you will need to do:

- Read the museum backgrounder for your station.
- Find the main ideas and write a three-minute script for your station tour.
- Make posters and hands-on displays for your tour.

Step 1—Learn by Example

Please take out your museum backgrounder. Your job is to tell the story of your backgrounder to others and to create posters or displays that highlight the most important facts or ideas. Your boss, the museum director, has done a sample for you since you are new on the job. You will follow his example as you create your station tour.

Let's see how the director created a tour script and exhibit for the opening of your station. Of course the first thing he did was read the entire backgrounder. Then he underlined the most important ideas or facts—things he thought others should know or things he thought were particularly interesting. You can see what the director wrote down in the box at the bottom of this page. The next thing the director did was brainstorm a few ideas for the exhibits. You can see his ideas for exhibits in the box too.

Director's Sample

1. **Main Ideas**—The director wrote down the main ideas for the first section of your backgrounder. You will underline the main ideas on your backgrounder too.

   1) Paper is the number one material in the solid waste stream (40 pounds for every 100 pounds we throw away).

2. **Exhibits**—Next, the director jotted down some ideas for presenting the information to visitors touring your museum station. You will decide what types of exhibits your group will use.

   1) Make a poster with 100 little garbage bags. Color 40 of the bags to illustrate how much paper is in every 100 pounds of trash.

3. **Tour Script:**

   Hello and welcome to Station Six. We are going to explore paper and glass recycling. Let's talk about paper recycling first.

   Paper is the **number one** material in the solid waste stream. It beats out plastics, metals, grass clippings—everything! For every 100 pounds of trash you generate, 40 pounds are paper and paper products.

   That's why recycling paper can really help extend the life of landfills. Recycling paper has other advantages too. Besides saving landfill space, it saves trees, water, and energy. . .

After getting these ideas together, the director wrote a script to go along with the first part of your backgrounder. He wrote the script as if he was giving a tour to a group of people. You'll want to keep that in mind when you write your script too. You may read the director's tour script in the box at the bottom of page one.

Step 2—Learn by Doing

Now it's your turn. Your group can work together. Here's what you need to do:

1. **Read your backgrounder.**
   Read silently, or have one person read aloud as the others follow along.

2. **Underline the main ideas in each section.**
   The backgrounder is divided into sections with headings or boxes. Working section by section, each person should underline the main ideas on his or her backgrounder.

3. **Using your own sheet of paper, write down at least two ideas for exhibits for each section.**
   Again working section by section, decide what displays would make your station interesting. Remember, the exhibits will need to tie into your tour script.

4. **Write a tour script for your station.**
   Work together as a group to write the script for your station tour. (Choose one person to write down your group's script.)

   You may take sentences straight from the backgrounder if you want. Just keep in mind that you will be speaking to a group of people, so make your discussion conversational. You may want to ask your visitors questions, for example, or pass a display around for them to look at. You also will need to keep your script very short. You may need to combine sections of your backgrounder or eliminate a section if your script is running long. Remember, your tour should only take about three minutes!

   NOTE: Your teacher will be checking your progress periodically to make sure you're on the right track. Try to stay on schedule. Don't get so bogged down with details that you fall behind.

Step 3—Decide Who Does What

Next decide who will do what in your group. Who will be the tour guide(s)? Who will make which displays?

On a sheet of paper write down each person's name. Next to their name, jot down the person's tasks. This will ensure everything gets done on time.

Step 4—Creation!

Are your creative juices brewing? You have the next few days to create the displays to go along with your station and to refine your script.

More Help

Station Six Main Ideas—You'll want to be sure to include the following information in your station tour:

Paper is the number one material in the solid waste stream • Recycling paper could help save landfill space • Recycling paper has other benefits too • The types of paper that are usually recycled and why • Paper cannot be recycled again and again • Making recycled glass uses 30% less energy than making all-new glass • Glass usually is sorted by color because the color cannot be removed • The types of glass that can and cannot be recycled.

Hints for Making a Great Station Tour

- Try to involve your visitors in your station tour. Ask them questions or pose problems.
- Don't use too many posters for your exhibits. Try to use props or 3-dimensional displays as much as possible. Example: use beverage cans to represent garbage cans, etc.
- Once you have made your station tour, time it to see how long it is. You may need to eliminate information or re-write sentences if your presentation is running long.
- The tour guide(s) should memorize the script for the museum tour. Nobody wants to listen to somebody reading from a piece of paper.
- The tour guide(s) should rehearse in front of your group. Together you may come up with ways to improve the script or displays.

Station Guide—The Museum of Solid Waste and Energy

Station 7 — Waste-to-Energy

How to Make Your Museum Station

Congratulations! The Director of the Museum of Solid Waste and Energy has just hired your group to be museum curators. (A curator is someone who is in charge of caring for an exhibit at a museum or zoo.) Your group will create Station Seven. Other museum curators will be creating stations on different solid waste and energy topics. Together you will create an eight-station tour for the Museum of Solid Waste and Energy. Your class, school, or even your entire community will be invited to tour your station.

So, roll up your sleeves. Here is a quick look at what you will need to do:

- Read the museum backgrounder for your station.
- Find the main ideas and write a three-minute script for your station tour.
- Make posters and hands-on displays for your tour.

Step 1—Learn by Example

Please take out your museum backgrounder. Your job is to tell the story of your backgrounder to others and to create posters or displays that highlight the most important facts or ideas. Your boss, the museum director, has done a sample for you since you are new on the job. You will follow his example as you create your station tour.

Let's see how the director created a tour script and exhibit for the opening of your station. Of course the first thing he did was read the entire backgrounder. Then he underlined the most important ideas or facts—things he thought others should know or things he thought were particularly interesting. You can see what the director wrote down in the box at the bottom of this page. The next thing the director did was brainstorm a few ideas for the exhibits. You can see his ideas for exhibits in the box too.

Director's Sample

1. **Main Ideas**—The director wrote down the main ideas for the first section of your backgrounder. You will underline the main ideas on your backgrounder too.

   1) We can burn garbage and use its heat energy to make steam or electricity. That's just what we do with coal. 2) One ton of garbage equals the heat energy in 500 pounds of coal.

2. **Exhibits**—Next, the director jotted down some ideas for presenting the information to visitors touring your museum station. You will decide what types of exhibits your group will use.

   1) Get five lunch bags. Write 500 pounds on each bag. Label four of the bags as garbage and one bag as coal.

3. **Tour Script:**

   Hello and welcome to the waste-to-energy station. One way we can help solve our country's waste problem is to burn our garbage.

   Burning garbage is nothing new. It's probably as old as dumping garbage. But today we can burn garbage and use its heat energy to make steam for heating buildings or to generate electricity. That's what waste-to-energy is all about—turning waste into useable energy.

   Today most electric utilities burn coal, using the heat energy in coal to make electricity. Garbage doesn't have as much heat energy as coal though.

   Do you see the garbage bags on the table? It takes 2,000 pounds of garbage to equal the heat energy in just 500 pounds of coal. So waste-to-energy may not the cheapest way to make electricity, but it is a good way to cut down on landfill disposals while at the same time doing something useful with our garbage.

BEST COPY AVAILABLE

After getting these ideas together, the director wrote a script to go along with the first part of your backgrounder. He wrote the script as if he was giving a tour to a group of people. You'll want to keep that in mind when you write your script too. You may read the director's tour script in the box at the bottom of page one.

Step 2—Learn by Doing

Now it's your turn. Your group can work together. Here's what you need to do:

1. **Read your backgrounder.**
   Read silently, or have one person read aloud as the others follow along.

2. **Underline the main ideas in each section.**
   The backgrounder is divided into sections with headings or boxes. Working section by section, each person should underline the main ideas on his or her backgrounder.

3. **Using your own sheet of paper, write down at least two ideas for exhibits for each section.**
   Again working section by section, decide what displays would make your station interesting. Remember, the exhibits will need to tie into your tour script.

4. **Write a tour script for your station.**
   Work together as a group to write the script for your station tour. (Choose one person to write down your group's script.)

   You may take sentences straight from the backgrounder if you want. Just keep in mind that you will be speaking to a group of people, so make your discussion conversational. You may want to ask your visitors questions, for example, or pass a display around for them to look at. You also will need to keep your script very short. You may need to combine sections of your backgrounder or eliminate a section if your script is running long. Remember, your tour should only take about three minutes!

   NOTE: Your teacher will be checking your progress periodically to make sure you're on the right track. Try to stay on schedule. Don't get so bogged down with details that you fall behind.

Step 3—Decide Who Does What

Next decide who will do what in your group. Who will be the tour guide(s)? Who will make which displays?

On a sheet of paper write down each person's name. Next to their name, jot down the person's tasks. This will ensure everything gets done on time.

Step 4—Creation!

Are your creative juices brewing? You have the next few days to create the displays to go along with your station and to refine your script.

More Help

Station 7 Main Ideas—You'll want to be sure to include the following information in your station tour:

We can burn garbage to make steam and electricity • One ton of garbage has the same heat energy as 500 pounds of coal • It's not the cheapest way to make electricity, but it greatly reduces the amount of waste that is landfilled • After garbage is burned, all that is left over is a substance called ash • Strict rules require waste-to-energy plants to be clean-burning • Recycling and burning waste should be used together.

Hints for Making a Great Station Tour

- Try to involve your visitors in your station tour. Ask them questions or pose problems.
- Don't use too many posters for your exhibits. Try to use props or 3-dimensional displays as much as possible. Example: use beverage cans to represent garbage cans, etc.
- Once you have made your station tour, time it to see how long it is. You may need to eliminate information or re-write sentences if your presentation is running long.
- The tour guide(s) should memorize the script for the museum tour. Nobody wants to listen to somebody reading from a piece of paper.
- The tour guide(s) should rehearse in front of your group. Together you may come up with ways to improve the script or displays.

Station Guide—The Museum of Solid Waste and Energy

Station 8 — Landfilling

How to Make Your Museum Station

Congratulations! The Director of the Museum of Solid Waste and Energy has just hired your group to be museum curators. (A curator is someone who is in charge of caring for an exhibit at a museum or zoo.) Your group will create Station Eight. Other museum curators will be creating stations on different solid waste and energy topics. Together you will create an eight-station tour for the Museum of Solid Waste and Energy. Your class, school, or even your entire community will be invited to tour your station.

So, roll up your sleeves. Here is a quick look at what you will need to do:

- Read the museum backgrounder for your station.
- Find the main ideas and write a three-minute script for your station tour.
- Make posters and hands-on displays for your tour.

Step 1—Learn by Example

Please take out your museum backgrounder. Your job is to tell the story of your backgrounder to others and to create posters or displays that highlight the most important facts or ideas. Your boss, the museum director, has done a sample for you since you are new on the job. You will follow his example as you create your station tour.

Let's see how the director created a tour script and exhibit for the opening of your station. Of course the first thing he did was read the entire backgrounder. Then he underlined the most important ideas or facts—things he thought others should know or things he thought were particularly interesting. You can see what the director wrote down in the box at the bottom of this page. The next thing the director did was brainstorm a few ideas for the exhibits. You can see his ideas for exhibits in the box too.

Director's Sample

1. **Main Ideas**—The director wrote down the main ideas for the first section of your backgrounder. You will underline the main ideas on your backgrounder too.

   1) People have been dumping garbage for years. Today about 66% of our garbage is buried in landfills. 2) We will always need landfills because not all waste can (or should) be landfilled.

2. **Exhibits**—Next, the director jotted down some ideas for presenting the information to visitors touring your museum station. You will decide what types of exhibits your group will use.

   1) Make a colorful poster showing how much waste is landfilled today. 2) Display an old battery as an example of something that is not recyclable and should not be burned.

3. **Tour Script:**

   Hello and welcome to Station Eight, the last station of the Museum of Solid Waste and Energy.

   You've probably learned a lot about new ways of managing solid waste on your tour today. But let's look at an old waste management method. For sure, new ways to deal with solid waste are gaining ground, but there will always be a need for landfills.

   Why? Because not all solid waste can be recycled or burned. Plus, for some types of hazardous waste, landfilling is the safest disposal method.

   Take batteries for example. Batteries are not currently recycled, and they should not be burned because they contain mercury. A landfill is the best resting place for dead batteries today.

After getting these ideas together, the director wrote a script to go along with the first part of your backgrounder. He wrote the script as if he was giving a tour to a group of people. You'll want to keep that in mind when you write your script too. You may read the director's tour script in the box at the bottom of page one.

Step 2—Learn by Doing

Now it's your turn. Your group can work together. Here's what you need to do:

1. **Read your backgrounder.**
   Read silently, or have one person read aloud as the others follow along.

2. **Underline the main ideas in each section.**
   The backgrounder is divided into sections with headings or boxes. Working section by section, each person should underline the main ideas on his or her backgrounder.

3. **Using your own sheet of paper, write down at least two ideas for exhibits for each section.**
   Again working section by section, decide what displays would make your station interesting. Remember, the exhibits will need to tie into your tour script.

4. **Write a tour script for your station.**
   Work together as a group to write the script for your station tour. (Choose one person to write down your group's script.)

   You may take sentences straight from the backgrounder if you want. Just keep in mind that you will be speaking to a group of people, so make your discussion conversational. You may want to ask your visitors questions, for example, or pass a display around for them to look at. You also will need to keep your script very short. You may need to combine sections of your backgrounder or eliminate a section if your script is running long. Remember, your tour should only take about three minutes!

   NOTE: Your teacher will be checking your progress periodically to make sure you're on the right track. Try to stay on schedule. Don't get so bogged down with details that you fall behind.

Step 3—Decide Who Does What

Next decide who will do what in your group. Who will be the tour guide(s)? Who will make which displays?

On a sheet of paper write down each person's name. Next to their name, jot down the person's tasks. This will ensure everything gets done on time.

Step 4—Creation!

Are your creative juices brewing? You have the next few days to create the displays to go along with your station and to refine your script.

More Help

Station 8 Main Ideas—You'll want to be sure to include the following information in your station tour:

Landfilling is the number one method for getting rid of our garbage • We will always need landfills because not all waste can, or should be, recycled or burned • Today's sanitary landfills are a far cry from yesterday's open dumps • Landfills are designed to keep wastes in to protect the surrounding environment • That's why garbage degrades very slowly in a landfill • The methane gas produced in landfills can be used as an energy source.

Hints for Making a Great Station Tour

- Try to involve your visitors in your station tour. Ask them questions or pose problems.
- Don't use too many posters for your exhibits. Try to use props or 3-dimensional displays as much as possible. Example: use beverage cans to represent garbage cans, etc.
- Once you have made your station tour, time it to see how long it is. You may need to eliminate information or re-write sentences if your presentation is running long.
- The tour guide(s) should memorize the script for the museum tour. Nobody wants to listen to somebody reading from a piece of paper.
- The tour guide(s) should rehearse in front of your group. Together you may come up with ways to improve the script or displays.

Museum Project Sponsors

The National Energy Education Development Project would like to thank the folllowing organizations for their assistance with the Museum of Solid Waste and Energy:

Aseptic Packaging Council

Dart II Foundation

ITW Hi-Cone

Partnership for Plastics Progress

Ronald McDonald Children's Charities

Steel Can Recycling Institute

The National Energy Education Development (NEED) Project
P.O. Box 2518
Reston, VA 22090
(703) 860-5029

The NEED Project is a not-for-profit corporation dedicated to educating students, teachers, and the community about energy and environmental issues.